KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, JULY 18, 1884.

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OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

BY MONS. DE FONTENELLE.

WITH NOTES BY RICHARD A. PROCTOR.

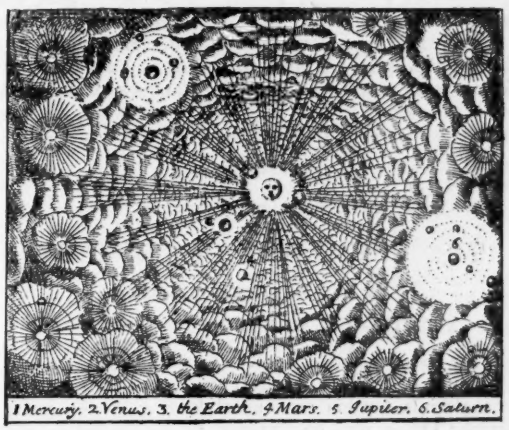
TO MONSIEUR L.

TO give you, Sir, a particular account how I pass'd my time in the country with the Marchioness of G . . . . , would amount to a volume; and what is worse, a volume of philosophy. I know you expected entertainments of other kinds, such as dancing, gaming, hunting, &c. Instead of which, you must take up with vortex's, planets, and new worlds; these were the subject of our conversation. And by good luck, as you are a philosopher, it will be no great disappointment to you, but on the contrary, I fancy, you will be pleas'd, that I have brought over the Marchioness to our party; we could not have gain'd a more considerable person, for youth and beauty are ever inestimable: If wisdom would appear with success to mankind, do you think she would do well to take upon her the person of the Countess? And yet was her company but half so agreeable, all the world would run mad after wisdom. But tho' I tell you all the discourse I had with the lady, you must not expect miracles from me. It is impossible, without her wit, to express what she said, in the same manner she spake it: For my part, I think her very learned, from the great disposition she has to learning. It is not poring upon books alone that makes a man of understanding. I know many that have done nothing else, and yet I fancy are not one tittle the wiser. But perhaps you expect, before I enter upon my subject, I should describe the lady's house, with its situation, &c. Many great palaces have been turn'd inside outward upon far less occasion. But I intend to save you and myself that labour; let it suffice that I tell you, I found no company with the Marchioness, and I was not at all displeas'd at it. The two first days drain'd me of all the news I brought from Paris; what I now send you is the rest of our conversation, which I will divide into so many parts, as we were evenings together.

THE FIRST EVENING.

That the earth is a planet which turns on itself and round the sun.

We went one evening after supper to walk in the park: the air was extremely refreshing, because that day had been very hot; the moon had been up about an hour, and her lustre between the trees made a most agreeable mixture of light and darkness; the stars were in all their glory, and not a cloud appear'd throughout the sky; I was musing on this awful prospect; but who can think long of the moon and stars in the company of a pretty woman! I am much mistaken if that's a time for contemplation.



1 Mercury. 2 Venus. 3. the Earth. 4 Mars. 5 Jupiter. 6. Saturn.

"Well, madam," said I to the Marchioness, "is not the night as pleasant as the day?" "The day," said she, "like a fair beauty, is clear and dazzling; but the night, like a brown beauty, more soft and moving." "You are generous, Madam," I reply'd, "to prefer the brown, you that have all the charms that belong to the fair; but is there anything more beautiful in nature than the day? The heroines of romances are generally fair; and that beauty must be perfect, which has all the advantages of imagination. "Tell not me," said she, "of perfect beauty, nothing can be so that is not moving. But since you talk of romances, why do lovers in their songs and elegies address themselves to the night?" "'Tis the night, Madam," said I, "that crowns their joys, and therefore deserves their thanks." "But 'tis the night," said she, "that hears their complaints, and how comes it to pass the day is so little trusted with their secrets?"

"I confess, Madam," said I, "the night has somewhat a more melancholy air than the day; we fancy the stars march more silently than the sun, and our thoughts wander with the more liberty, whilst we think all the world at rest but ourselves: besides, the day is more uniform, we see nothing but the sun, and light in the firmament; whilst the night gives us variety of objects, and shows us ten thousand stars, which inspire us with as many pleasant ideas." "What you say is true," said she; "I love the stars, there is somewhat charming in them, and I could almost be angry with the sun for effacing 'em." "I can never pardon him," I cried, "for keeping all those worlds from my sight." "What worlds," said she, looking earnestly upon me; "What worlds do you mean?"

"I beg your pardon, Madam," said I; "you have put me upon my folly, and I begin to rave." "What folly?" said she. "I discover none." "Alas!" said I, "I am ashamed, I must own it, I have had a strong fancy every star is a world. I will not swear it is true, but must think so

because it is so pleasant to believe it. 'Tis a fancy come into my head, and is very diverting." "If your folly be so diverting," said the Marchioness," "pray make me sensible of it; provided the pleasure be so great, I will believe of the stars all you would have me." "It is," said I, "a diversion, Madam, I fear you will not relish. 'Tis not like reading one of Moliere's plays; 'tis a pleasure rather of the fancy than of the judgment." "I hope," replied she, "you do not think me incapable of it. Teach me your stars, I will show you the contrary." "No, no," I reply'd, "it shall never be said I was talking philosophy at ten of the clock at night to the most amiable creature in the world. Find your philosophers somewhere else."

But in vain I excused myself: who could resist such charms? I was forced to yield, and yet knew not where to begin; for to a person who understood nothing of natural philosophy you must go a great way about to prove that the earth may be a planet, the planets so many earths, and all the stars worlds. However, to give her a general notion of philosophy, I at last resolved on this method.

(*To be continued.*)

THE CHEMISTRY OF COOKERY.

By W. MATTIEU WILLIAMS.

XXXVIII.—COUNT RUMFORD'S COOKERY.

IN my last I referred to Rumford's anticipation of the results of modern chemical analysis in his selection of the materials for his economical feeding of the poor of Munich; but, as may be supposed, all his theoretical speculations have not been confirmed. The composition of water had just been discovered, and he found by experience that a given quantity of solid food was more satisfying to the appetite and more effective in nutrition when made into soup by long boiling with water. This led him to suppose that the water itself was decomposed by cookery, and its elements recombined or united with other elements, and thus became nutritious by being converted into the tissues of plants and animals.

Thus, speaking of the barley which formed an important constituent of his soup, he says, "It requires, it is true, a great deal of boiling; but when it is properly managed, it thickens a vast quantity of water, and, as I suppose, *prepares it for decomposition*" (the italics are his own).

We now know that this idea of decomposing water by such means is a mistake; but, in my own opinion, there is something behind it which still remains to be learned by modern chemists. In my endeavours to fathom the rationale of the changes which occur in cookery, I have been (as my readers will remember) continually driven into hypotheses of hydration, *i.e.*, of supposing that some of the water used in cookery unites to form true chemical compounds with certain of the constituents of the food. As already stated, when I commenced this subject I had no idea of its suggestiveness, of the wide field of research which it has opened out. One of these lines of research is the demonstration of such true chemical hydration of cooked gelatine, fibrine, cellulose, casein, starch, legumin, &c. That water is *with* them when they are cooked is evident enough, but that water is brought into actual chemical combination with them in such wise as to form new compounds of additional nutritive value proportionate to the chemical addition of water, demands so much investigation, that I have been driven to merely theorise where I ought to demonstrate.

The fact that the living body which our food is building up and renewing contains about 80 per cent. of water, some of it combined, and some of it uncombined, has a notable bearing on the question. We may yet learn that hydration and dehydration have more to do with the vital functions than has hitherto been supposed.

The following are the ingredients used by Rumford in "Soup No. 1":—

	Weight. Avoirdupois. lb.	oz.	Cost. £	s.	d.
4 *viertels* of pearl barley, equal to about 20½ gallons	141	2	0	11	7½
4 *viertels* of peas	131	4	0	7	3½
Cuttings of fine wheaten bread	69	10	0	10	2½
Salt	19	13	0	1	2½
24 *maass*, very weak beer, vinegar, or rather small beer turned sour, about 24 quarts	46	13	0	1	5½
Water, about 560 quarts	1,077	0		—	
	1485	10	1	11	9
Fuel, 88 lb. dry pine wood			0	0	2½
Wages of three cook maids, at 20 florins a year each			0	0	3½
Daily expense of feeding the three cook maids, at 10 creutzers (3 pence ¾ sterling) each, according to agreement			0	0	11
Daily wages of two men servants			0	1	7½
Repairs of kitchen furniture (90 florins per ann.) daily			0	0	5½
Total daily expenses when dinner is provided for 1,200 persons			1	15	2¾

This amounts to $\frac{422}{1200}$ or a trifle more than $\frac{1}{3}$ of a penny for each dinner of this No. 1 soup. The cost was still further reduced by the use of the potato, then a novelty, concerning which Rumford makes the following remarks, now very curious. "So strong was the aversion of the public, particularly the poor, against them at the time when we began to make use of them in the public kitchen of the House of Industry in Munich, that we were absolutely obliged, at first, to introduce them by stealth. A private room in a retired corner was fitted up as a kitchen for cooking them; and it was necessary to disguise them, by boiling them down entirely, and destroying their form and texture, to prevent their being detected." The following are the ingredients of "Soup No. 2," with potatoes.:—

	Weight. Avoirdupois. lb.	oz.	Cost. £	s.	d.
2 viertels of pearl barley	70	9	0	5	$9\frac{1}{2}\frac{1}{2}$
2 viertels of peas	65	10	0	3	$7\frac{3}{4}$
8 viertels of potatoes	230	4	0	1	$9\frac{2}{11}$
Cuttings of bread	69	10	0	10	$2\frac{1}{4}$
Salt	19	13	0	1	$2\frac{1}{4}$
Vinegar	46	13	0	1	$5\frac{1}{2}$
Water	982	15		—	
Fuel, servants, repairs, &c., as before			0	3	$5\frac{5}{12}$
Total daily cost of 1,200 dinners			1	7	$6\frac{3}{4}$

This reduces the cost to a little above one farthing per dinner—$1\frac{1}{40}$ exactly.

In the essay from which the above is quoted, there is another account, reducing all the items to what they would cost in London in November, 1795, which raises the amount to $2\frac{3}{4}$ farthings per portion for No. 1, and $2\frac{1}{2}$ farthings for No. 2. In this estimate the expenses for fuel, servants, kitchen furniture, &c., are three times as much as the cost at Munich, and the other items at the prices stated in the printed report of the Board of Agriculture of November 10, 1795.

But since 1795 we have made great progress in the right direction. Bread then cost one shilling per loaf, barley and peas about 50 per cent. more than at present, salt is

set down by Rumford at 1¼d. per lb. (now about one farthing). Fuel was also dearer. But wages have risen greatly. As stated in money, they are about doubled (in purchasing power, *i.e.*, real wages, they are three-fold). Making all these allowances, charging wages at six times those paid by him, I find that the present cost of Rumford's No. 1 soup would be a little over one halfpenny per portion, and No. 2 just about one halfpenny. I here assume that Rumford's directions for the construction of kitchen fireplaces and economy of fuel are carried out. We are in these matters still a century behind his arrangements of 1790, and nothing short of a coal-famine will punish and cure our criminal extravagance.

The cookery of the above-named ingredients is conducted as follows:—"The water and pearl barley first put together in the boiler and made to boil, the peas are then added, and the boiling is continued over a gentle fire about two hours; the potatoes are then added (peeled), and the boiling is continued for about one hour more, during which time the contents of the boiler are frequently stirred about with a large wooden spoon or ladle, in order to destroy the texture of the potatoes, and to reduce the soup to one uniform mass. When this is done, the vinegar and salt are added; and, last of all, at the moment that it is to be served up, the cuttings of bread." No. 1 is to be cooked for three hours without the potatoes.

As already stated, I have found, in carrying out these instructions, that I obtain a purée or porridge rather than a soup. I found the No. 1 to be excellent, No. 2 inferior. It was better when very small potatoes were used; they became more jellied, and the purée altogether had less of the granular texture of mashed potatoes. I found it necessary to conduct the whole of the cooking myself; the inveterate kitchen superstition concerning simmering and boiling, the belief that anything rapidly boiling is hotter than when it simmers, and is therefore cooking more quickly, compels the non-scientific cook to shorten the tedious three-hour process by boiling. This boiling drives the water from below, bakes the lower stratum of the porridge, and spoils the whole. The ordinary cook were she "at the strappado, or all the racks in the world," would not keep anything barely boiling for three hours with no visible result. According to her positive and superlative experience, the mess is cooked sufficiently in one-third of the time, as soon as the peas are softened. She don't, and she won't, and she can't, and she shan't understand anything about hydration. "When it's done, it's done, and there's an end to it, and what more do you want." Hence the failures of the attempts to introduce Rumford's porridge in our English workhouses, prisons, and soup kitchens. I find, when I make it myself, that it is incomparably superior and far cheaper than the "skilly" at present provided, though the sample of skilly that I tasted was superior to the ordinary slop.

The weight of each portion, as served to the beggars, &c., was 19·9 oz. (1 Bavarian pound); the solid matter contained was 6 oz. of No. 2, or 4¾ oz. of No. 1, and Rumford states that this "is quite sufficient to make a good meal for a strong, healthy person," as "abundantly proved by long experience." He insists, again and again, upon the necessity of the three hours' cooking, and I am equally convinced of its necessity, though, as above explained, not on the same theoretical grounds. No repetition of his experience is fair unless this be attended to.

The bread should *not* be cooked, but added just before serving the soup. In reference to this he has published a very curious essay entitled "Of the Pleasure of Eating, and of the means that may be employed for increasing it," the discussion of which must be postponed until my next, together with the details of the more luxurious *menu* of the first company of the Elector's own Grenadiers, who were fed upon boiled beef, soup, and dumplings at the large cost of twopence per day, and other regiments variously fed at about the same cost.

Before concluding this paper, I must add a few words in reference to the amusing fiasco of Mr. Albert Dawson, described in No. 139, page 486. I scarcely thought it necessary in writing for intelligent people to remind them that the length of time which any kind of moist food may be kept varies with the temperature and the place in which it is kept. Most people know that a leg of mutton which, on the average, should hang for about a week, may advantageously hang for a month or more in frosty weather, and be spoiled if kept at midsummer in an ill-ventilated place for two days. The fate of Mr. Dawson's porridge is an illustration of this simple principle. Judiciously kept, it becomes slightly sour; this sourness is due to the conversion of some of the starch into sugar, and the acetous fermentation of some of this sugar. The vinegar thus formed performs the function of that supplied by Count Rumford to his porridge. It renders it more digestible, and assists in its assimilation. The re-heating of the oatmeal porridge drives off any disagreeable excess of acid that may have been formed, as acetic acid is very volatile.

Tastes may vary as regards this constituent. For example, my old friend (to whom I referred), the late William Bragge (so well known in Birmingham, Sheffield, and South America), preferred his porridge when thus soured; other members of his family say that it lost the original aroma of the oatmeal. Be that as it may, I have no doubt that the ensilaged porridge, ounce for ounce, supplied more nutriment and demanded less work from the digestive organs than the freshly-made porridge. Probably this advantage may be obtainable more agreeably by Rumford's three hours' boiling, and his wilful addition of the vinegar.

MAN AND NATURE.

IT is well known that the larger game of the far West has been long diminishing in numbers. This is especially true of the bison, an animal which is unable to escape from its pursuers, and which can hardly be called a game animal. The once huge Southern herd has been reduced to a few individuals in North-western Texas. The Dakota herd numbers only some 75,000 head, a number which will soon be reduced to zero if the present rate of extermination continues. The Montana herd is now the object of relentless slaughter, and will soon follow the course of the other two herds. When scattered individuals represent these herds, a few hunters will one day pick them off, and the species will be extinct.

Let the Government place a small herd in each of the national parks, and let the number be maintained at a definite figure. Let the excess escape into the surrounding country, so as to preserve the species for the hunters. Let herds of moose, elk, big-horn, black and white-tailed deer, and antelope, be maintained in the same way. Let the Carnivora roam at will; and in a word, protect nature from the destructive outlawry of men whose prehistoric instincts are not yet dead. Let the newer instinct of admiration for nature's wonders have scope. Let the desire for knowledge of nature's greatest mystery—life—have some opportunity. Let there be kept a source of supply for zoological societies and museums, so that science may ever have material for its investigations. By securing the preservation of these noblest of nature's works, Congress will be but extending

the work it has so grandly sustained in the past, in the support of scientific research and the education of the people.—*The American Naturalist.*

OPTICAL RECREATIONS.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

(*Continued from page 34.*)

WE have seen what happens (Fig. 16, p. 33) when a ray of light passes from a rarer medium into a denser one, whereof the boundaries are parallel, and out again into the rarer medium. Let us investigate now what will occur if, instead of our plate of, say, glass having parallel sides, those sides are inclined to each other.

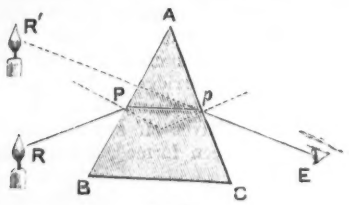


Fig. 18.

Let A B C in Fig. 18 represent the section of such a stalk of glass (known technically as a prism), and bearing in mind the principles enunciated on p. 32, and illustrated in Fig. 15, let us trace the course of a ray of light, R P *p* E, incident on one face of our prism at P; then at P we draw the perpendicular to the surface A B, represented by the dotted line. Now it will be seen that on passing from air into glass our ray R P will be bent *towards* this perpendicular, and will travel in the direction P *p*. At *p* we erect another perpendicular, and, as the student by this time must be well aware, the emergent ray will now be bent *from* this, and will travel in the direction *p* E. Hence any object, such as a candle-flame, placed at R, and viewed through a prism with its base downwards, by an eye situated at E will be seen in the direction R′ *p* E. It will not only be seen to be thus displaced, but its edges will appear to be fringed with the exquisite colours of the rainbow, though with this phenomenon we have no immediately present concern. It has its origin in the fact that ordinary white light is a compound of coloured lights, and that each of these colours is bent at a different angle, red being the least bent, and violet or lavender the most deflected. It is this dispersion of light which lies at the basis of what is called Spectrum Analysis, of which our Editor has announced his intention of himself treating in these columns. For our present purpose we must consider that we are dealing with light all of one colour. Very well then, with this temporary qualification, the angle formed by R P and *p* E is called "the angle of deviation," and the greater the angle between the sides of our prism, or the greater the refracting power of the material it is composed of, the greater will this angle of deviation become. Note here particularly that in whatever position we place the prism, the emergent ray, *p* E, will deviate towards the thicker part, or base, of the prism B C. Now, everybody knows what a convex or magnifying-glass is, and if we suppose Fig. 19 to represent a section of such a glass, we shall see that, in effect, it consists of two prisms, A B C, D B C, placed base to base, and that parallel rays, R R R, &c., from a distant object will be so bent as all to unite at F, the principal focus of the lens, when they will form an image of the object, just as in the case of the

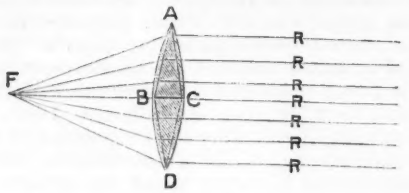


Fig. 19.

concave mirror whose action was described and illustrated on p. 436. And here, again, we have an illustration of that law which can never be too often insisted on—viz., that rays of light go and return by the same route, for if we place a very small bright light at F, the rays diverging from it will be rendered parallel by the lens, and emerge in that condition on the other side of it. Suppose, though, that we remove our light to a point outside of the principal focus of the lens, then, instead of the rays issuing from its distal face being parallel, it will be seen that they will be convergent; in fact, an image of the source of light will be formed on a screen held at a suitable distance on the other side of the lens. Conversely, if the light be shifted to the position occupied by the screen, its image will be formed at the point which it occupied before such shifting. These interchangeable points are called the "conjugate foci" of a lens. All this may be compared with the properties of a concave mirror explained on p. 436. It is evident that, if we obtain a lens whose focal length equals the width of the room shown in Fig. 2 (p. 306), and put this in the place of the simple hole in our shutter, we shall obtain a much more brilliant and distinct image of the external landscape on the wall; in fact, we shall have constructed a primitive form of the camera obscura. The form the camera takes, as arranged for public exhibition, is shown in Fig. 20.

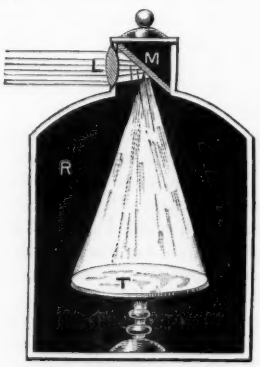


Fig. 20.

Here we have a light-tight room, R, usually of octagonal or cylindrical shape, containing a table T covered with plaster of Paris or painted with dead-flat white paint. Above is a box turning in a ring containing the convex lens L placed vertically, and behind it the mirror M at an angle of 45°, the effect of this arrangement obviously being that the image formed by the lens is reflected down on to the table T, where the spectator sees a charming miniature view of the external landscape, with its drifting clouds, running water, and moving forms of animal life. One of the most familiar uses of a convex lens is that illustrated in Fig. 21.

We mean as a magnifying glass. Here the object (suppose a tiny arrow) *a w* is placed just within the principal focus of the lens, and the rays from it being caused to converge to the eye at E seem to come from a much larger arrow A W. The image thus perceived is, of course, a *virtual* one only, as contradistinguished from the real image formed by the camera obscura, as just described. It is needless to discuss the passage of light through a concave lens here, as we are not writing a treatise on optics. It may suffice to say that, *mutatis mutandis*, its action is comparable with that of a convex mirror (p. 437)—*i.e.*, it renders rays of

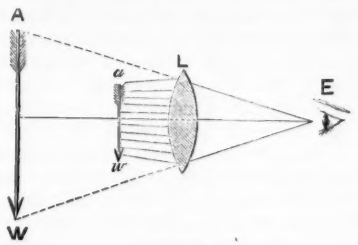


Fig. 21.

light passing through it more divergent, just as is the action of a convex lens with the effect produced by a concave mirror, in causing them to converge more. A convex lens, too, fulfils another function—that of grasping a number of rays of light, which varies as the square of its aperture. A "burning-glass" illustrates this property admirably. Let us suppose that we have a convex lens of 3 in. in diameter and of 6 in. focus. Then the image of the sun formed in that focus will be only 0·0558 in. in diameter. But this image is formed by *all* the rays incident on the 3-inch aperture of the lens; and, as we know that the area of circles vary as the squares of their diameters, we have only to divide 3^2 by $0{\cdot}0558^2$ to see at once how relatively enormous must be the concentration of light and its concomitant heat in the sun's image projected by a lens of our assumed size and focus. When such a lens is made of sufficient dimensions, its effect is astounding. Parker constructed a flint lens of 32 in. in diameter, of 6 ft. 8 in. focus; using together with it a second one of 13 in. diameter and 29 in. focus to further concentrate the converging rays. These lenses were so arranged that their combined focal length was 5 ft. 3 in. With this combination, 10 grains of slate were melted in 2 sec., and 10 grains of pure platinum in 3 sec. Nay, even so utterly refractory a substance as rottenstone disappeared in vapour in 1 min. 20 sec. under the inconceivable intensity of the heat thus generated! Similar experiments were made a few years ago with a lens built up of segments, at the Crystal Palace, under which a halfpenny was vaporised in a comparatively few seconds.

(To be continued.)

ELECTRO-PLATING.

VIII.

By W. SLINGO.

AS was intimated a fortnight since, a deposit of copper, if it is allowed to assume any considerable thickness, loses very materially in definition, so far, that is, as concerns the outer or exposed surface. Although the deposit may often, under the most advantageous circumstances, be made to retain the general features and beauties of the mould, such a result must not be habitually looked for; but where plating is preferable to typing, the necessity for allowing only a thin deposit must not be overlooked. It is far better, where a good and substantial deposit is required, to obtain a type. Even, however, were it otherwise, the mere production is in itself interesting and instructive, and is certainly a stepping-stone to higher and better achievements.

It is in the nature of things that casts should be more or less undercut, and as it is my purpose here to deal with the problem of copying models in high relief, it will probably be better for us to concentrate our attention upon some particular form. Let us imagine that we desire a representation in copper of a small bust or statue, classical or otherwise. Now, it will be apparent on the briefest reflection that such a model cannot be copied in plaster or any other of the rigid materials used in making moulds from comparatively flat models such as coins or medals. Were our model a metal bust we could, of course, take a copy of it by enveloping it in a bath of wax or some other acid-proof substance, and then dissolve out the metal by means of acid, but that plan would rarely be desirable, more particularly if the metal were valuable, or of an obstinate nature, requiring nitric acid to dissolve it.

A better way, by far, is to use what is known as an elastic mould. A brief reference was made to such a material in the fifth of this series of articles (KNOWLEDGE, No. 134). It was there said that such a mould could be made from glue and treacle. If the figure to be copied is small, two pounds of the finest glue is broken up into small pieces and soaked in cold water until it becomes quite soft. Any water that remains unabsorbed is poured off, and the gelatinous mass is then placed in a glue-pot with half-a-pound of treacle, and heated to nearly 100° C. (boiling point of water). To comply with this does not, of course, require a thermometer. A glue-pot, properly speaking, consists of two pots, one inside the other, the inner one containing the glue and the outer one containing water. The two so fitted are placed on the fire, and, as doubtless most people are aware, the most intense fire is incapable of raising the glue to a higher temperature than that of the water through which the heat is transmitted, and that water, as water, cannot, above the sea-level, be raised to a higher temperature than 100° C. (or 212° F.), any heat passing into the water after such a temperature has been attained being absorbed in the conversion of the water into steam. So long, then, as there is water in the outer vessel, the temperature of the inner one cannot exceed the boiling-point of water.

The mixture of glue and treacle during the process of heating should be thoroughly stirred, so as to ensure a uniform resultant compound. An ounce or so of beeswax may be added with advantage.

Supposing, now, that the bust or figure to be copied is made of plaster, its surface must manifestly be well prepared so as to make it non-porous, otherwise the mixture will get into the interstices and render it impossible to effect a separation. The plaster, therefore, should be stood or laid in a shallow dish containing oil and thoroughly saturated. If a metal or other "solid" model, it requires well oiling to prevent the mixture adhering to it. A vessel, such as a jar, or a pail if the figure is a large one, is then procured and its interior well oiled. Presuming the model to be hollow, it is filled with sand, in order to increase its weight. It is then placed head downwards in the jar, a mark being made on the outside to indicate the position of the back of the figure. The mixture being warm, is then poured in, but not too rapidly to prevent the escape of any air bubbles that might collect in one or other of the various crevices of

the figure. The jar is filled up to an inch or two above the figure. Thus filled, the jar is placed aside for a couple of days or so, until, in fact, the mixture is thoroughly set. The jar is then turned upside down, and a tap or two releases the mixture from the sides of the jar, that is unless the shape is an unusual one, preventing the mould from slipping out. It is scarcely necessary to say that the best form of vessel is one that tapers slightly towards the bottom. The position of the back of the model being known (by the mark placed on the outside of the jar), a clean, thin sharp knife is inserted in the mould over the head of the model, and passed down its back, keeping close to the figure. The mixture which has cooled over the base of the model is also carefully removed. The mould, being highly elastic, may then be opened with the hands, and another pair of hands being called into requisition, the model may be removed. The mould, in virtue of its elasticity, springs back on being released, and we thus obtain a good negative representation of the figure. We may, if we so please, take our copy from this mould, but the task is rather a troublesome one, and the result often disappointing. The admixture of treacle with the glue prevents the shrinking which would otherwise take place on cooling, but it does not overcome the tendency to absorb water. Such an absorption would matter little were it not that it produces a considerable swelling, when the proportions of the figure would be entirely lost. Nor would our troubles end here. The absorption may, however, be prevented by adding to the hot mixture of glue and treacle a small quantity of tannic acid to the extent of two per cent. of the quantity of glue when cold. Another mode of excluding water is to immerse the elastic mould in a weak solution of bichromate of potash and allow it to dry in the sun. A thin impervious film is thereby deposited. A good waterproof coating is that previously referred to as guttapercha varnish, made by dissolving the percha in bisulphide of carbon. This, obviously, must not be applied to the interior of the mould, or we should get no deposit. The inner surface may, however, be well protected by a thoroughly good coating of plumbago, which must be deposited, as facilities do not present themselves for rubbing the blacklead in. Of this, however, more anon. The mode of procuring the deposit must also be deferred for a few minutes.

Whether the elastic mould is or is not used to receive the copper deposit, it should be bandaged up so as to prevent it falling out of form, as its elasticity would otherwise cause it to.

When the deposit is not intended to be taken in the elastic mould, it may be placed back in the vessel in which it was moulded. A second mixture is then made by melting together 2 lb. of beeswax, $1\frac{3}{4}$ lb. of resin, and a $\frac{1}{4}$ lb. of tallow. During the heating the materials require to be well stirred so as to ensure an intimate mixture. The vessel containing the mixture should then be placed on one side for a short time, until it has nearly set. It is then poured gently into the cavity in the elastic mould until it is filled up. The jar thus filled is put aside for some hours until everything is quite cool, when it is inverted, and the elastic mould with the beeswax mould inside it slips out. The former may be again opened, and the latter withdrawn. Had the beeswax been poured in when warm it would most probably have melted, and maybe have united with the treacle mixture, and so have spoiled it. The beeswax mould thus obtained is obviously a copy of the model, and can hardly be used to obtain an electrotyped copy direct. It is, however, placed in the jar in a position akin to that occupied by the original figure. A thin plaster of Paris paste is next prepared and poured steadily into the jar up to the level of the base of the mould. When the plaster is thoroughly dry, the beeswax copy is melted out, and we have thus a plaster of Paris negative.

It is evident that such a mould cannot have plumbago rubbed over its internal surface. To get a conducting surface the cavity is washed out two or three times with a solution composed of 32 grains of phosphorus to 480 grains ($1\frac{1}{3}$ oz.) of bisulphide of carbon. After this it is washed-out with a solution of silver nitrate, one pennyweight of the nitrate being dissolved in a pint of distilled water. The plaster mould being prepared, it is placed in the bath, or it may, for the matter of that, form its own bath. The cavity is filled with the blue-stone solution, and, the conducting surface being connected with the zinc pole of the battery, the copper pole is connected to the anode, which should consist of a mass of copper as near the general proportions of the figure as possible. It has previously been pointed out that a great deal depends upon the resistance in the bath, that is to say upon the relative distance between the anode and the mould. It is almost impossible to emphasise too strongly the necessity that really exists for keeping the anode as nearly parallel as possible with the various parts of the mould. When the substance to be coated is cylindrical, it is almost enveloped by two bent sheets of copper. When the mould is full of irregularities, it is placed at a considerable distance from the anode so that the relative differences of resistance are reduced to a minimum. The resistance introduced by increasing the distance is compensated for by the addition of another cell, that is to say, by increasing the electro-motive force. Where there are a few cavities, the deposit is sometimes started in them first by using a small anode, and placing it in them. Another device is that of employing leading wires, as indicated a fortnight since.

It is advisable, when coating a mould, such as the one in hand, to cause a current of the liquid to flow through it, otherwise the solution will degenerate. This is considerably facilitated by boring a small hole in the bottom of the mould, somewhere near or on the back of the head.

Sometimes, more especially when the model is a large one, the mould is made in two, or perhaps a number of pieces. To make it in two, the model is embedded to half its depth in fine sand, the surrounding surface being made fairly level, two or more pegs are stuck in the sand, and then, a little thin plaster having been brushed rapidly into the crevices, a quantity of plaster is poured on. When it has set it is removed with the model. The level surface of the sand being spread over with oil, the reverse side of the model is moulded in a manner similar to that adopted with the first half. The plaster is then placed in a shallow tray containing stearine until it is well saturated, when it is taken out and thoroughly and carefully plumbagoed. The electrotype is taken in halves, and when both halves have attained a sufficient thickness they are trimmed, and the edges soldered together, the joint being carefully bronzed over. This process, however, cannot be adopted where there is any considerable undercut, such as would be met with, for example, in taking a copy of a figure recumbent on a base. The number of pieces would then have to be more numerous, unless the elastic mould process were resorted to.

Very large objects are generally sacrificed, but of this more in my next.

THE Gas Company at Leipzig intends, says a contemporary, to ask the Municipal Council of that town for a concession for lighting the streets and houses by electric light.

THE ENTOMOLOGY OF A POND.

BY E. A. BUTLER.

THE MIDDLE DEPTHS (*continued*).

ABOUT a month after the hatching of the eggs, it is time for this aquatic life to close, and an existence less gross and far more ethereal now lies before the little creature, which has, however, by this time nearly completed the cycle of its mortal life, and so has but scant opportunity left to enjoy the greater freedom and pleasures which the acquisition of superior powers will bring. Within that ugly, limbless pupa case has been formed a delicate, long-legged, feathery-horned, two-winged, sylph-like being, which, like the Prince in the old story of "Beauty and the Beast," is but waiting the removal of its hideous disguise to appear in all its rightful elegance and grace. The moment of deliverance having at length arrived, the pupa tail is brought up level with the surface, a considerable part of the thorax being thereby caused to rise above the water. The skin then splits between the two horns, and the imprisoned fly begins to emerge at the opening. This is the most critical moment in its whole career, for with head and thorax released, but legs still encumbered by their encasement, the creature is perfectly helpless and, at the same time, rather top-heavy, so that a sudden gust of wind may in a moment capsize the tiny boat and disappoint the hopes of the half-liberated fly, which can then look forward to nothing but a miserable death by drowning. If, however, no such mishap occurs, the struggling insect gradually drags out first one pair of legs and then another, and then, leaning forward, rests them on the water and draws out the third pair; then making use of the empty pupa skin as a sort of canoe, it soon dries its wings and mounts aloft to join its companions, who everywhere around are at the same time putting on their adult costume. In their society we will leave it for the present, hoping to meet it again later on.

The larvæ of the midges are called bloodworms, and are probably familiar to everyone who has kept a rain-water butt, for such receptacles often swarm with the wriggling, blood-red, worm-like things. They are also abundant in ponds, and, indeed, in any stagnant water. The remarks made above concerning the life-history of the gnat apply in great measure to the present insects also. These red, worm-like things, however, must not be confounded with a certain red worm that also inhabits fresh water, forming vertical burrows in the mud of rivers; they are gregarious, and crowd their tiny burrows close together, remaining with their bodies partly protruded, and thus forming large red patches upon the mud, and it is amusing to see the sudden disappearance of such a patch as they all sharply retreat into their holes on the approach of an intruder. These, however, are not insects at all, but true worms, or, as they are called in scientific language, annelids, and have reached, in this vermiform condition, the highest stage in their development. The fly, which is the parent of the red wrigglers of the water-butt and stagnant pond, is called *Chironomus plumosus*. The larva is rather more worm-like than that of the common gnat, and the pupa carries some elegant plumes of fine hairs on its ungainly thorax.

There is a beautiful little creature, clear and transparent as crystal, that is the larva of another member of this group, and is noteworthy for the variety of curious appendages it carries on the fore-part of its body. Imagine an animal with a pair of arm-like bodies consisting of a stem with long bristles at the end, and used to lash the water, then a stout bundle of hairs movable *en masse*, then a pair of little saws, then a kind of policeman's truncheon, with bunches of hairs at the end, also capable of swaying backwards and forwards, and then a pair of jaws and a set of bristles, and you will see at once that *Corethra plumicornis*, as it is called, must have enough to do to manage properly all these contrivances. Such is its transparency, that it may easily elude observation till its wriggling, jerky motions betray its presence. This same transparency, however, affords wonderful facilities to the microscopist for the study of its internal anatomy and physiology, for, by aid of the microscope, all that is going on in its interior is made plainly visible. It is, of course, a distinct advantage to be able to study the action of an animal's internal organisation without interfering with the free action of its parts, or placing it under abnormal conditions, as there is thus less chance of mistaking for essential peculiarities accidental ones, such as might be induced by the altered circumstances. It is not to be wondered at, therefore, that this creature has become classic by having been made the subject of elaborate investigation by more than one observer; and, indeed, there are few more entrancing occupations to those who have a desire to search out the secrets of nature than to watch, hour after hour, under a good microscope, the varied actions and vital processes of this and other minutiæ of animal life. It must not be ignored, however, that the very transparency of parts tends also to introduce a certain element of difficulty into the investigation; for where several organs overlie one another it is not always easy to trace their relative position, and it becomes necessary to examine the object from different points of view before such a matter can be settled.

Through the transparent skin of Corethra can be seen, first the whole of the digestive apparatus, forming a long tube of varying diameter, stretching almost from one end of the body to the other; then, on one side of this (the mouth side) can be traced the greater part of the nerve system, looking like a long string, with knots tied in it at tolerably regular intervals. Where it approaches the mouth, however, the string divides, and sending one branch on each side of the throat tube, terminates on the opposite side of the digestive tract in a double mass of nervous matter, which is all the representative of brain the poor creature possesses. Then all down the back (to be traced with a little more difficulty, on account of its extreme transparency) is the "dorsal vessel," as it is called, which is an insect's equivalent of a heart. Those who have kept silkworms or other pale, smooth-skinned caterpillars, will probably have noticed this apparatus as a dark line running along the back just underneath the skin, and alternately contracting and expanding from behind forwards at the rate of from forty to fifty pulsations per minute; in the present insect the pulsations are not so rapid, being only about twelve per minute. Then there can be seen the numerous oblique bands of muscles by which it is enabled to effect its wriggling movements, as well as those strips by which the motions of its various appendages are controlled. Again, at each of two places, one near the head, the other much farther down, will be noticed a pair of black bags, which are air-receptacles connected with the system of breathing-tubes distributed over the body; the tracing of these latter, however, is, on account of their extreme minuteness, a matter of much more difficulty. At the tail there are two tufts of feathery hairs, one at the end, the other at the side; small though they are, the hairs are hollow, and connected at their base with the tracheal system, and, whatever other function they discharge, they evidently take part in that of respiration. All these aquatic fly larvæ are more or less transparent, but we have chosen the present for more de-

tailed reference, because its superior transparency renders it best adapted for microscopical investigation. Like the rest of its brethren, it is carnivorous, and its favourite dish seems to be the quaint little creatures called, from their spasmodic, jerky movements, water fleas, though they are not fleas at all, nor, indeed, even insects, but belong to the group of animals of which crabs, lobsters, and shrimps are the most familiar representatives. These specks of creation, which are considerably more minute than our household fleas, are caught and crunched by Corethra in considerable numbers, and with great avidity. To facilitate the crushing of their hard horny skin, it is furnished with a pair of strong jaws, carrying stout, tooth-like projections.

(To be continued).

SUPERSTITION.

IT is noteworthy how closely superstition and ignorance are allied. The dynamiters have shown us what a low and ignorant class of savages still exists in Ireland, and beyond a doubt most of the trouble which exists in Ireland, and is caused by the Irish lower classes wherever they make their abode, arises from the sheer ignorance of the race. There is no country in Europe, perhaps, unless it be in the more murderous parts of Italy, where superstitions of the stupidest sort are more prevalent than in Ireland among the ignorant members of the community. Consider, for instance, the edifying scene presented at a spot about 100 yards from the place where the Dublin Invincibles were hanged. Here is a well called the Well of St. John, the foulness of whose waters, though to the eye they seem tolerably clear, has caused medicinal properties to be imputed to them, after the customary notion of the ignorant that the effectiveness of medicines is proportional to their loathsomeness of taste or smell, or both. But (probably because these waters become particularly offensive at midsummer) the ignorant of that region regard the water of this well as especially curative if taken thence on the eve of June 24, now St. John's day, though the tradition dates unquestionably from times long preceding the Christian era. This silly superstition (amazingly silly in this age) is so firmly believed in by the ignorant, and there are so many ignorant folk round about Kilmainham, that, on June 23 last, quite 5,000 people assembled at the well, having made a pilgrimage thither from greater or less distances. It is regarded by these unfortunate idiots as essential that the water should be drawn before daylight on St. John's eve, and the pilgrims came provided with every class of vessel to bring away the precious fluid (precious stuff). The well is in a recess under a wall, we are told, and candles had to be used to light the people down the steps, so that the scene presented was of a weird character. I have seen such *weird* scenes, and most melancholy they are. Watch a detachment of the Salvation Army going along with the savage and silly noises in which they delight and note the degraded type of countenance of every single member of the procession. Imagine 5,000 persons of still stupidier and more animal type groping about with candles to gather foul water in dirty vessels, mumbling unmeaning incantations to strengthen its virtue—a scene weird enough for a Rembrandt to paint; only, if he would not make it too utterly melancholy for all who long to see the human race becoming better and wiser, he should let gloom and darkness hide all the worst features of the scene. Truly, a man must keep such scenes from his thoughts, even as he must refrain from thinking of the squalor of our ill-fed and worse clothed poor, if he would believe that man is but a little lower than the angels, or else he must have strange ideas of the angels. Thinking of the ways of some who are closely akin to these superstitious and ignorant beings—I mean the dynamiters—he might well conclude that man is but a little higher than the devils, according to accepted ideas as to these folk.—R. A. PROCTOR, in the *Newcastle Weekly Chronicle.*

THE INTERNATIONAL HEALTH EXHIBITION.

VIII.—WATER AND WATER-SUPPLIES—(*continued*).

A RETROSPECTIVE inquiry into the statements made in our last communication would show that it is chiefly by the action of carbonic acid gas, oxygen, organic matter, and hydration, that water is enabled to act upon the substratum of our earth. By means of these reactions it is endowed with properties which it would otherwise never possess, and a little reflection would convince one that those attributes are wholly dependent upon the character of the formations through which it penetrates. Let us now proceed to trace the physical history of the water which saturates the earth's crust, and which is destined to play a most important part in the laboratory of Nature; in doing so we shall be able to unravel the mysteries of the Plutonic region, and gain an insight into the principles which we shall have to bear in mind when we come to consider the practical aspect of the water question in its relation to man.

The dry bones of natural philosophy are capable of being rendered highly delectable when the results of abstruse calculations are reduced to round numbers and put forth as astounding realities; at least, so they seemed to us in our college days, when the learned professor laid aside the garb of austerity to discourse upon the wonders of the "unseen universe," and material creation, to his awe-stricken class of undergraduates. We were taught that in the far-off hazy annals of the world, at a time which is only so far definite as to allow of a licence of computation between twenty to forty millions of years ago, the earth was in the condition of the sun of our present era, and that through the radiation of the heat into space, it slowly cooled down to become fitted for the habitation of living things. (On the authority of our University pedagogue, we may state that sufficient heat leaves the earth per annum to melt a film of ice one quarter of an inch thick, spread over its entire surface). It does not much matter to us whether that happy time was consummated six millions, or only six thousands of years ago; suffice it to say that the only evidences we have of the former intense heat of the earth now are to be traced to the vestiges of internal temperature, which we are made aware of in our comparatively trivial borings, which show a rise of about 1° C. for every 100 feet of descent into a mine, and to those natural operations which manifest themselves in volcanic outbursts, fiery lakes, and thermal springs. The late Principal Forbes has shown that irrespective of the nature of the soil, the changes of temperature due to the rotation of the earth upon its axis, or that caused by day and night, is only perceptible to a depth of one foot; and that the seasons do not affect the earth's crust, as far as temperature is concerned, to a greater depth than from 28 to 30 feet.

Water which penetrates into the earth, then, has to contend against these thermal sources; by them it is endowed with solvent and other properties, in addition to those

which it possesses as a chemical re-agent. The densest rock and the stiffest clay are yet so porous as to give it ready access, and so great is the power of capillarity, in virtue of which it descends, that Daubrée's experiments* have proved conclusively that it is able to resist the great effects of counter pressure of vapour and internal heat, and to establish itself in the form of a gas at the roots of volcanoes and far down in the depths of the earth; how far has not yet been ascertained.

But, although stiff clays are permeable, they may be regarded as practically impervious; they are only stiff clays because they hold, in intimate admixture, a large proportion of water. Suppose, then, that a stratum of clay supports a sandy porous soil as at Fig 15, which represents the condition of things which obtain at Hampstead Heath. The major portion of the rain-water is filtered by the sand,

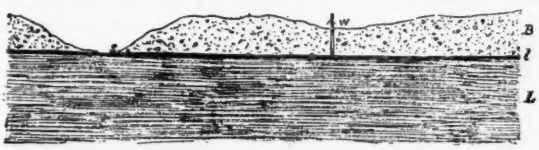


Fig. 15.—B., Bagshot sand; *l.*, water-bearing stratum; L., London clay; *s.*, spring; *w.*, well.

and collects above the clay in a sort of water-bed. At certain parts the clay is laid bare by a cessation of the overlying sand, by a natural depression, as at *s* (Fig. 15), or by an artificial boring as at *w* (Fig. 15); *s* gives forth a natural spring, *w* is called a well. Now, remove all the Bagshot clay and lay bare the London clay, as at Fig. 16, which depicts an hypothetical section across the London basin. The sandy strata, known as the Lower London Tertiaries, underlie the clay, and the whole rests upon the uppermost beds of the mesozoic age, termed the cretaceous or chalk formations. The London clay takes

Fig. 16.—Hypothetical section across the London basin. L. London clay; *t.*, porous strata of the Lower London Tertiaries; *c.*, chalk; *l.*, water-level; *w.*, well.

in but little water; the exposed surface of the sandy tertiaries at *t* and the chalk at *c* are saturated, and the water finds its way through both until it reaches the so-called water level (indicated by the dotted line in Fig. 16), or underground reservoir, which pervades the crust of the earth irregularly, and at depths which vary with the nature of the soil, the seasons, and the external configuration of the surface.† Thus, under a plain, it is in reality tolerably level; beneath a hill it becomes convex; in a valley somewhat concave, or, it may be, altogether irregular on account of the differences of the rock textures through which the water is forced to pass, or because of their unconformability. A boring such as that shown at *w*, Fig. 16, is called a well; since *t* and *c* are at higher levels than *w*, the water, in virtue of the law of hydrostatics, rises up the bore of the well to its outlet, and forms the kind of artificial spring called an Artesian well.*

Thus far we have only taken into account springs and wells such as obtain in comparatively unbroken strata. In other regions, however, where seismic action has been rife, where numerous faults intersect the country, and where the rocks lie more or less out of their strict order of succession, springs are to be sought for chiefly at escarpments and in the line of faults. In Fig. 17 the water-bearing strata are shown in shaded bands, whilst the sandy beds are dotted; *f, f,* are the outlets of powerful springs which rise up the fissures due to faults.

Fig. 17.—*f, f,* Powerful springs rising at faults; *s*, porous sandy beds; *w*, water-bearing strata.

Thus it appears that the rain-water which penetrates the earth is not permanently removed from the surface, but rises again to well forth as springs, along joints and fissures, charged with substances in solution and suspension which are characteristic of the formations through which it passes. Some of the water, however, is absorbed, and other portions combine chemically with certain constituents in the rocks. Its underground course, moreover, is not confined to capillary percolation, but often assumes the character of subterranean streams and reservoirs,† which are the extended representatives of former crevices and fissures. These are so pronounced in some cases as to materially affect the water-supply of rivers—to drain or to swell them; curious facts illustrative of this have been recorded by Desor,‡ and the occasional presence of plant-stems, leaves, and even of fish, in recently-made Artesian springs, are additional and interesting proofs of the underground circulation of water.

The descent of rain-water into the depths of the earth to regions of peculiar mineral salts, and their subsequent rise in the form of springs, provides us with the so-called natural mineral waters, for a detailed account of which we must refer the reader to Gairdner's exhaustive "Memoir."§ In like manner, thermal springs are the result of heat derived from the interior of the earth. If we attribute the heat thus gained by the water to the greath depth of its origin, then, by allowing 1° Fahr. for every 60 feet of descent, when the surface temperature is about 50° Fahr., the springs of Bath, which average 120° Fahr., ought to come from a depth of at least 4,200 feet.

Let us now turn to a consideration of the London

* "Géologie Expérimentale," p. 274; Tschermak, "Sitz. der Wiener Akademie," March, 1877; Reyer, "Beitr. zur Physik. der Eruptionen," § 1.

† In the case of chalk formations, the surface waters which are absorbed by the upper strata find their way by capillary percolation and through fissures into the deeper portions, which then become saturated and simulate retentive clays. It is in this way that water-bearing strata are extemporised in chalk, and, as one would expect, they are often transitory.

* So-called after the village of Artois, in France.

† A paper on "The Underground Waters of England and Wales" was read before the Geologists' Association on June 6, last, by Mr. C. E. De Rance.

‡ "Bull. Soc. Sci. Nat.," Neufchâtel, 1864.

§ "Essay on the Nature, History, Origin, and Medicinal Effects of Mineral and Thermal Springs," Edinburgh, 1832.

XUM

water supply as an example of special interest to the inhabitants of this vast metropolitan centre. The eight water companies, whose graceful pavilion in the Exhibition we shall visit ere long, derive their water almost wholly from the Thames district. Five of them draw upon the Thames and its tributaries directly, two have recourse to the river Lea, whilst the Kent company resort to deep wells in the chalk for its supply.

The sixth report of the Rivers' Pollution Commissioners states that the "catchment basin" of the Thames is one of the finest which has ever come under their notice. Of an area of 6,000 square miles, more than one-half consists of cultivated porous soil, its yield of water being delivered chiefly through springs. The remaining impervious superficial strata consist chiefly of meadow and pasture lands, and from them the rain-water drains off into the runnels which feed the river and its tributaries.

The extreme western tributary of the Thames, called the Churn, arises in the "Seven Springs," situated about four miles from Cheltenham, on the road to Cirencester. These springs rise from the clay beds of the Lias, the water having accumulated through the porous formations of the inferior oolitic limestones, which contain large underground reservoirs; they yield about 150,000 gallons of water daily. About four million gallons of water, which have passed through similar formations, are derived daily from the Syreford spring, at the head of the river Colne. Three million gallons are daily pumped up at the Thames' head, from a depth of 35 feet, to the level of the Thames and Severn canal; this water passes through the lower oolitic formations, known as the Bath or the Great Oolite, to be stored by the marls and clays of the so-called beds of the Fuller's earth. Other springs of importance which originate in the Fuller's earth are those of Boxwell, Ewen, and Ampney. Minor tributaries of the Thames derive their supply from the Gault clays, which underlie the beds of the Upper Greensand, the porous collecting-ground of which consists of siliceous and calcareous sands, with green grains and chert nodules.

With the exception of the river Loddon, which is supplied from the Bagshot sands resting on the London clay, nearly all the rest of the water of the Thames is derived from the chalk formations. Of this character are the supplies of the Kennet, which culls its waters from the downs near Marlborough and Hungerford, the Colne, and the so-called New River. In addition to all these sources, the Thames is largely fed by springs which arise in its own bed, the most famous examples of which are situated between Reading and Wallingford.

From what has been stated it may be gathered that the water of the Thames is essentially a calcareous water, all its chief sources of supply being derived from limestones and calcareous sands, with the single exception of the river Loddon, which flows through the ferruginous and other sands of the Bagshot series. The Kent Company's water, which is obtained from deep chalk wells, is even more calcareous than the Thames water; so that we may here make the general statement that the most characteristic feature of the London water is its hardness.

The class of workmen who have been actively employed in railroad construction for the last few years have probably suffered more from want of work than other classes (in America) during the comparative quiet that has lately existed in many industries. This has been especially the case with Italians and other foreigners who came to the country in large numbers during the flush labour times, but are now in large numbers without employment in Chicago and other large cities. Their want of knowledge of any other labour but railroad work tells against them.—*Railway Review* (Chicago).

BRITISH SEASIDE RESORTS,

FROM AN UNCONVENTIONAL POINT OF VIEW.

By Percy Russell.

I.

IT was the favourite idea of the author of the "History of Civilisation"—that imposing fragment of a grand conception—that a people would correspond psychologically to the nature of their immediate physical environment. The idea is in itself in no way new, and has been universally found to furnish the key to all the peculiarities of national temperament, and thence it may, I think—passing from the abstract to the concrete—be fairly assumed that the love of the sea in general will be found proportioned to the extent of coasts in any particular country, and very especially in proportion to the sinuosities and general accessibility of the coast itself, while, of course, the question of average temperature and other meteorological conditions are necessarily important, and sometimes determining factors in the creation of a general national fondness for "blue water."

For one thing, it is difficult for the average Englishman to understand the utter indifference of the mass of the inhabitants of Central Europe for the ocean in any of its aspects, and the notion of a "seaside season," which is with ourselves a matter of course, would be an idea really impossible to convey adequately to the normal mind of a dweller in Central Europe.

It may, perhaps, however, be news to some that the number of islands, great and small—many very small indeed—composing what is known as the group of the British Isles, exceeds five thousand. It is true, certainly, that many of these are mere shelves of rock, but still the fact remains that the geographical term, Great Britain and Islands, implies an archipelago of over five thousand islands. Irrespective, too, of the mass of the outlying islands, from the Scilly group to the Orkney and Shetland Isles, the total length of the coast-line from Berwick to the South Foreland, thence to the Land's End, and from the Land's End to Berwick again, approaches two thousand miles, taking bays, inlets, and harbours into account, and thus it is possible for the excursionists around our own shores to accomplish a distance equal to a fourth of the actual diameter of the entire globe!

These are very rudimentary facts indeed, but they escape many among us who are commonly reckoned, and probably justly so, as being well informed generally. They are, however, I think very suggestive facts, and, for one thing, unquestionably furnish the clue to the undoubtedly strong passion of Englishmen for the sea, which was, curiously enough, much more intense as a passion before the epoch of iron ships began.

Whether or no our maritime character is becoming considerably modified by the various material influences and altered conditions of our present complex civilisation, it is not my business to inquire in this place, but it may be safely said that the normal Englishman, Englishwoman, and child are longing for the sea in summer, and directly the mercury rises in the thermometer to a certain point, that very large class known as the social "Everybody," begins to hasten coastwards, and the seaside season fairly sets in. It goes without saying that, as a general rule, English people are not remarkable for method or thought in their pleasures and recreative arrangements, and thence it is that, in general, comparatively a few watering-places are thronged and packed with visitors for a season, and a large proportion of people made very uncomfortable, and not a few exceedingly ill, simply because

the vast majority of heads of families deciding on a seaside holiday are led by names rather than things, and all flock off to comparatively a few places, which most of them know a little better than their own neighbourhoods, having had more leisure for the study; and thus it follows that, to a great extent, the essential framework and normal conditions of town life are precipitated on the select and fashionable places of seaside resort, and a number of unsanitary conditions produced which ought never to exist, while the special pleasures which would be derived from the seaside, minus these conventional municipal features, are but rarely attained, and are even unknown to many who have, however, had the barren experience brought to them of very many annual seaside seasons. For one thing, the majority of persons are lamentably ignorant, I fear, as to the character of the coasts of their own country, beyond the few miles of it that they have actually seen at the very few watering-places they have visited. They continue going, mechanically almost, to the same place, and thus continue to reproduce in their recreative environments the very same viciously monotonous conditions which they are professedly seeking to escape when, with exhausted bodies and weary minds, they at last decide on a change.

Many excellent and truly scientific* monographs now exist as to the thermal conditions and general meteorologieal aspect of the principal British coasts and surrounding seas, and any one desirous of such information can easily ascertain the exact character of the prevalent winds at any particular place, the chemical constituents of the air, and so forth. This, however, is the higher science of what may be called our seaside philosophy, and taking humbler and more easily practicable phases, I would first give a rapid sketch of the salient and picturesque features of the coasts of the British islands, and having noticed rapidly their principal picturesque features, I shall then proceed to give an outline, with all the needful practical particulars for guiding aright intending visitors, of sundry places of beauty and interest on our own coasts which are even now little known, and less frequented, by the mass of people as places of health-resort or recreative retirement. It is manifestly absurd for people to continue visiting the same places, or the same small group of familiar places, year after year, and then, as some do, proceed abroad on the plea that there is nothing fresh for them to see in their own country!

First, however, let me say a word as to the general features of the coasts of the United Kingdom. The western coast, broadly, then, is formed by four deep and very wide bays, divided by enormous buttresses of land thrust far out to sea. The scenery is wild and magnificent. Tremendous cliffs and masses of rocks fortify the shore, and generally tower above the sea with rugged, but grand, profiles. These cliffs are mostly composed of exceedingly ancient and very hard rocks, and have for ages successfully resisted wind, frost, and even the insidious rain, and still present very much the same features seaward that they have done for the last two or three thousand years. As a natural effect of this formation we have here a very deep sea and remarkably powerful tides. Here, too, the waves may be studied in their might, and present an aspect under even a moderate gale which is altogether unlike anything ever to be seen on the south coast.

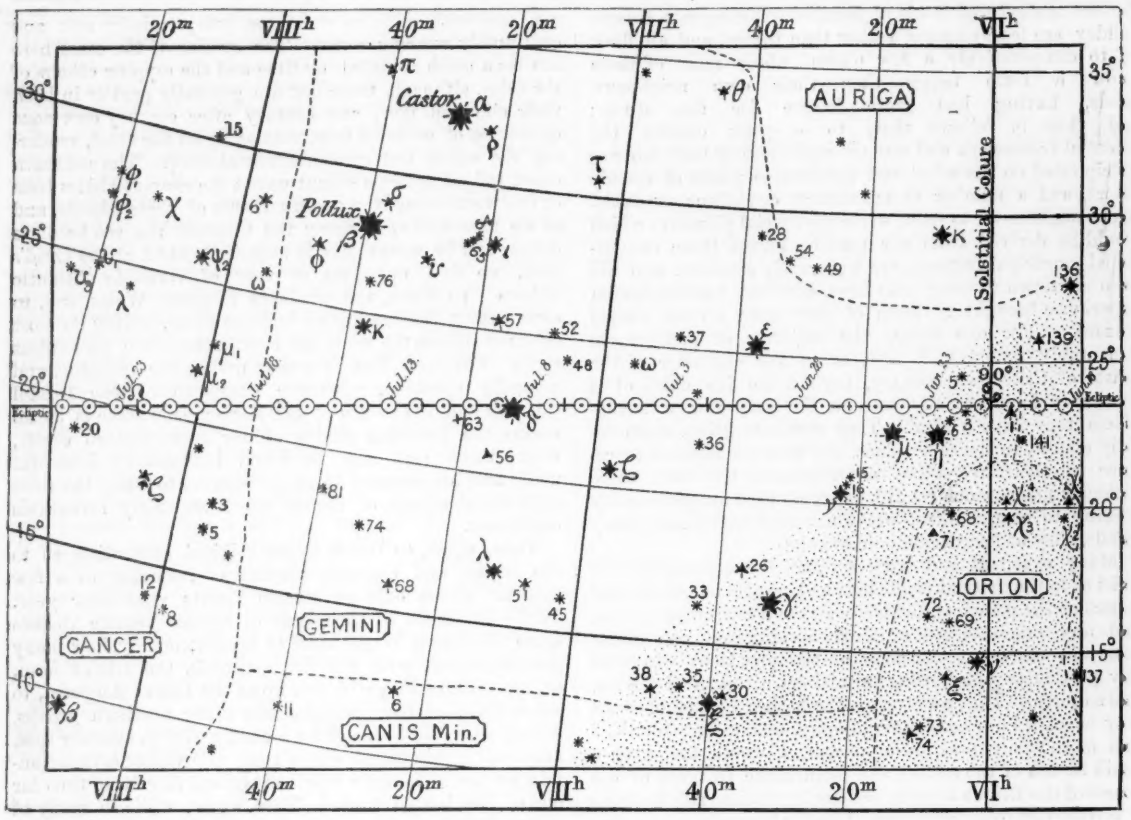
On the east, in strong antithesis to the west, we find a rather monotonous coast, usually sloping away south-east, and having few or only comparatively unimportant headlands and not much cliff. The bays, or rather their equivalents, are generally formed by rivers discharging into the sea, and such cliffs as exist are comparatively soft and continually wearing away. The outline of the coast here has been much modified by time and the sapping effects of the tides, although these last are generally gentler in both their ebb and flow, and century after century enormous quantities of material is accumulating off the coast, rendering the ocean bed comparatively shallow. The southern coast, indeed, to some extent unites the characteristics both of the western and the eastern shores of these islands, and as we pass westward along the Channel the sea becomes deeper and its waves grow in magnitude until, at the Land's End, we find ourselves in view of veritable Atlantic billows. In truth, the whole of England, Wales, and, to some extent, Scotland, is an inclined plane, having its most elevated side on the west, and having there, too, its hardest rocks. Cardigan Bay is nearly useless for shipping, and generally speaking, with the exception of the Bristol Channel and the mouth of the Mersey, commerce is by no means the presiding genius of our great western coasts, where there may still be found innumerable beautiful nooks and unsurpassed vantages wherein to study the most picturesque aspects of the sea under unusually favourable conditions.

Then, again, to revert to my original contention as to the capital and common blunder of recurring to a few familiar places only as seaside resorts year after year. While hundreds of thousands of regular seaside visitors know the Isle of Wight more or less thoroughly, how many are acquainted with the Scilly Islands, the Isle of Man, or, more interesting still, put up at the Isle of Anglesea, to say nothing of the Hebrides and other northern groups, which, when they are set for a brief period in summer seas, are in all senses places which repay the visitor a thousandfold for the little extra trouble involved in getting thus far out of the beaten track? Then, again, while so many of us are familiar with Portsmouth Harbour, Southampton Water, and the very faint stretches of blue water off the south coast, how many, comparatively speaking, are familiar with the magnificent Bristol Channel, with Swansea Bay, Milford Haven, St. Bride's Bay, Morecambe Bay, and the splendid Solway Firth? How few, again, among the tens of thousands who throng the esplanades of the fashionable and popular south and east coast watering-places are acquainted with the formation of the Devonian heights which rear themselves in such stately beauty and culminate at last at a height of 1,700 feet, while on the north this lofty table-land falls grandly to the sea in precipitous cliffs? Then there are the beautiful Cornish highlands, combining much of the romantic and stern beauty of North Britain with the softer graces and luxuriant vegetation of the sunny south. These remarkable hills, which commence on the lovely shores of Bideford Bay, contracting thence, form but a single line of remarkable heights—a kind of English Apennines—sloping abruptly to the sea on each side, and ending in the bold and splendid headland at the extremity of Cornwall, where may be studied the volcanic cliffs off Lizard Point, and where the Scilly Isles, far out at sea, remain mute but eloquent witnesses of the extent of this remarkable peninsula before some awful convulsion rent away its southern extremity and swallowed up what must have been in pre-historic times a kind of Italy attached to a group of islands, which seemed to some of the ancient Romans to be lost among the dreary snowstorms of the Ultima Thule.

(To be continued.)

* See "English Seaside Resorts," Vol. II., pages 3, 18, 39, 91, 109, 162, 176, 211, 306.

As a protection against blow-flies, the best thing is creosote. If placed in various positions near and around the meat, no fly will go near it. Pyroligneous acid has the same effect.



Day Sign for the Month.

ZODIACAL MAPS.

BY RICHARD A. PROCTOR.

WE give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

THE ANTARCTIC REGIONS.

BY R. A. PROCTOR.

(*Continued from page* 31.)

THE enormous icebergs which come from out the Antarctic seas suggest interesting conclusions respecting regions as yet unexplored. This will be understood when it is remembered that all the larger and loftier icebergs have in reality had their origin in immense glaciers. Vast masses of ice are formed, indeed, in the open sea. Each winter the seas which have been open during the summer months (December, January, and February) are covered over with ice of enormous thickness, and when summer returns the ice-fields thus formed are broken up, and the fragments, borne against each other during storms, become piled into gigantic masses. But the agglomerations thus formed, vast though they are, are far exceeded in magnitude by the true icebergs. "Among the drifting masses of flat sea-ice," says Tyndall, "vaster masses sail which spring from a totally different source. These are the icebergs of the polar seas. They rise sometimes to an elevation of hundreds of feet above the water, while the height of ice submerged is about seven times that seen above." "What is their origin?" he proceeds, speaking of those met with in the northern seas. "The Arctic glaciers. From the mountains in the interior the indurated snows slide into the valleys, and fill them with ice. The glaciers thus formed move, like the Swiss ones, incessantly downwards. But the Arctic glaciers reach the sea, and enter it, often ploughing up its bottom into submarine *moraines*. Undermined by the lapping of the waves, and unable to resist the strain imposed by their own weight, they break across, and discharge vast masses into the ocean. Some of these run aground on the adjacent shores, and often maintain themselves for years. Others escape, to be finally dissolved in the warm waters of the ocean."

It is important to notice that the Antarctic icebergs are vaster and more numerous than those formed in Arctic seas. How large these last are will be understood from the instance referred to by Tyndall, who, citing Sir Leopold MacClintock, describes an Arctic iceberg 250 ft. high, and aground in 500 ft. of water. But Captain Maury speaks of Antarctic icebergs in the open sea, hundreds of feet high and "miles in extent." "The belt of ocean that encircles this globe on the polar side of fifty-five degrees south latitude is never free from icebergs," he adds; "they are formed in all parts of it all the year round. I have encountered them myself as high as the parallel of thirty-seven degrees, . . . and navigators on the voyage from the

Night Sign for the Month.

Cape of Good Hope to Melbourne, and from Melbourne to Cape Horn, scarcely ever venture, except while passing Cape Horn, to go on the polar side of fifty-five degrees." As he justly remarks, "the nursery for the bergs to fill such a field must be an immense one; such a nursery cannot be on the sea, for icebergs require to be fastened firmly to the shore until they attain full size. They, therefore, in their mute way, are loud with evidence in favour of Antarctic shore-lines of great extent, of deep bays where they may be formed, and of lofty cliffs whence they may be launched."

It is remarkable, however, that Maury fails to notice that the evidence of these enormous icebergs is opposed to the theory of an Antarctic continent, or is, at least, by no means in favour of that theory. It might at once be objected, indeed, to the inferences derived by Maury from the Antarctic icebergs, that similar reasoning would show the unknown parts of the Arctic regions to be mainly occupied by land masses. But, apart from this, all that we know of glaciers teaches us to recognise the fact that they are formed only in regions where vast mountain ranges exist, and where the lower levels are reached by ravines and valleys gradually diminishing in slope as they descend. Now, wherever this is the contour of the land, we have in the surrounding regions one or other of the three following conditions:—Either (i.), flat land regions around the base of the mountain ranges; or (ii.), inland seas upon which the valleys debouch; or (iii., and lastly), open sea, in which the mountain ranges form islands or pinnacles complicated in figure. It is clear that only the third of these formations corresponds to the conditions indicated by the Antarctic icebergs. There must be a communication between Antarctic seas and the mountain-slopes of Antarctic lands, and this communication must be by long and deep valleys, descending to fiords, bays, and gulfs. It is thus as certain as such a matter can be until the eye of man has actually rested on these regions, that the Antarctic shores are extremely irregular; and it seems altogether more probable that the land-masses of Antarctic regions consist of a number of large islands like those in the seas to the north of America, than that there is a great continental region, broken along its border, like the Scandinavian peninsula, into bays and fiords.

But, strangely enough, Captain Maury actually recognises the necessity for a suitable region within which the icebergs are to be formed, but seems to feel bound (by the opinion of geographers respecting the unknown Antarctic regions) to reconcile the existence of such a region with the theory of a great Antarctic continent. "Fiords, deep bays, and capacious gulfs loom up," he tells us, "before the imagination, reminding us to ask the question, Is there not embosomed in the Antarctic continent a Mediterranean, the shores of which are favourable to the growth and the launching of icebergs of tremendous size? and is not the entrance to this sea near the meridian of Cape Horn, perhaps to the west of it?" But the condition of the Antarctic seas will not permit us to adopt such a view of the origin of southern icebergs. Even if the imagined Antarctic

Mediterranean were not icebound, it would be sufficiently difficult to conceive that the glaciers formed around its shores would pass out in stately procession through the imagined straits south and west of Cape Horn. How should currents sufficiently strong be generated to bear these glacial masses away? How could collisions, blocking up the mouth of the strait, often for months together, be avoided? And when the consideration is added that an Antarctic Mediterranean would almost certainly be frozen over the whole year through, the theory that it is within such a sea that Antarctic glaciers are formed becomes, in our opinion, altogether untenable. If such a sea exists, it must be blocked up with ice too completely for any considerable movements to take place within it. Even the glaciers on its borders must be unlike the glaciers known to us, because the downward motion of the ice-masses composing them must be so checked by the resistance of masses already accumulated, as to be scarcely perceptible even in long periods of time.

(To be continued.)

THE ABSOLUTE CAPACITY OF A CONDENSER.

AT the last meeting of the Physical Society, Mr. R. T. Glazebrook, M.A., F.R.S., of Cambridge University, described some interesting experiments he had made to determine, in absolute measure, the electrical capacity of a condenser sent to him for the purpose by Messrs. Latimer Clark, Muirhead, & Co., the well-known makers. The general method employed by Mr. Glazebrook is that given by Clerk Maxwell in his treatise on "Electricity," vol. II., sec. 776. A commutator driven by a tuning-fork is fitted to the condenser in such a manner that the plates of the condenser are alternately connected to two points at different electrical potentials, and then put into communication with each other. The condenser and commutator are inserted as one of the arms of a Wheatstone bridge, and Maxwell has shown that if the period of vibration be sufficiently slow, the combination is approximately equivalent to a resistance of $\frac{1}{n\,C}$ where n is the frequency of the tuning-fork, and C the capacity of the condenser. Thus, if a be the resistance of the arm conjugate to the condenser, c and d resistances of two other conjugate arms, we have the condition for a balance $\frac{a}{nC} = c\ d$, or $n\ C = \frac{a}{c\ d}$. Thus C can be found if a, c, d, and n be known. Mr. J. J. Thomson has, however, shown ("Phil. Trans.," part iii., 1883) that Maxwell's formula is only approximate, and has given the correct formula. It was this which Mr. Glazebrook used in his tests, and the arrangement of apparatus is shown in the figure. The condenser and commutator were placed on the bridge arm B D, and P is the moving piece commutator, which, when in contact with S, changes the condenser, and, when in contact with R, discharges it. The tuning-forks used had frequencies of 16, 32, 64, and 128 to the second, as determined by careful comparison with a clock by the method of Lord Rayleigh. The corresponding values of the capacity were, in terms of the legal ohm., ·3336 mf. (microfarads), ·3340 mf., ·3335 mf., and ·3337 mf., the mean being .3337 microfarads. The experiments do not show any variation in the capacity, as the time of charging is changed from 1-16th to 1-128th of a second. The formula also gives a ready and accurate means of determing the pitch of a tuning-fork, for if the capacity of the condenser used is known, the value of n can be determined. Mr. Glazebrook has successfully used it for this purpose. A question arose at the meeting as to the efficacy of mercury contacts in such experiments, and Dr. W. H. Stone stated that he found mercury and iron contacts to be free from sticking. Whether this is an advantage or not in making a good contact is doubtful. Recent experiments within our knowledge would seem to point to a microphone action in such contacts.—*Engineering.*

Reviews.

SOME BOOKS ON OUR TABLE.

Picture-making by Photography. By H. P. ROBINSON. (London: Piper & Carter. 1884.)—Many a photographer whose technical manipulation is perfect, whose plates never fog, and the half-tones of whose negatives leave nothing to be desired, fails dismally in the production of anything resembling an artistic picture. That it will not merely suffice to that end to stick up a camera in front of a view or group, and subsequently to expose and develop a plate, Mr. Robinson's excellent manual not only conclusively shows, but points out definitely why, in the plainest and most comprehensible manner. His little book should be in the hands of every one who is anxious to preserve the element of beauty in his reproductions of nature, and is not contented with a mere wooden and mechanical copy of the objects he depicts by the aid of the camera.

The London Water Supply, its Past, Present, and Future. By G. PHILLIPS BEVAN, F.S.S. (London: Edward Stanford. 1884.)—Beginning with an account of the water supply of mediæval London from the Thames, the Fleet, the Tybourne, the Wallbrook, &c., Mr. Bevan carries us down to the existing provision for the metropolis, and gives full details with reference to the various water companies to which we are indebted for it, their plant, sources of supply, and profits; concluding his book with an account of the various schemes which have been devised for a large increase in the amount of water to be furnished, by bringing it from distant sources, such as Wales and Cumberland. Considering how probably imminent legislation is on the subject of the water supply of London, and how vastly its 4,000,000 inhabitants are interested in the question of the purity and economy of such supply, Mr. Bevan's small work should address a very large public indeed.

The A B C Guide to Physical Geography. (London: Thomas Young, 1884.)—The leading physical features of the earth's surface are set forth in this little book in a way calculated to give a fair rudimentary idea of them. After two perusals of it, we have come to the conclusion that the author means to be funny; but we speak with some hesitation on this point.

Gas-Burners, Old and New. By OWEN MERRIMAN. (London: Walter King. 1884.) Mr. Merriman gives us a complete history and description of gas-burners, from Murdock's original crude nipple, with its three perforations, through the bat's-wing and fish-tail forms down to the highly complicated and elaborate ones devised by Siemens, Clamond, and others; and the more simple, but practically equally efficient, burners of Sugg, Bray, and Brönner. The work before us may well tend to dissipate a good deal of unreasoning prejudice against gas-lighting, and to indicate how—at all events for domestic purposes—it will hold its own against the electric light for many a long day yet.

Vivisection in its Scientific, Religious, and Moral Aspects. By E. D. GIRDLESTONE, B.A. (London: Simpkin, Marshall, & Co. 1884.) *The Utility and Morality of Vivisection.* By G. GORE, LL.D., F.R.S. (London: J. W. Kolckmann. 1884.)—We have classed these two pamphlets together, inasmuch as they have one common aim: to plead for our right to experiment (of course under due restrictions) on the lower animals, for the benefit of mankind. Any impartial person who will read these *brochures* through with the attention that they deserve, will be able to estimate at its true worth the cant of those who ride and drive horses which have been subjected to a most painful form of "vivisection" (as probably as not by an ignorant country farrier), who eat veal that has been slowly bled to death, who will leave a pheasant with its thigh shattered by shot to die in a ditch, but who shriek with horror if a frog is decapitated, or the larynx of a dog opened, to obtain knowledge that may benefit thousands of suffering human beings.

Vaccination, by ALEXANDER WHEELER. (London: E. W. Allen. 1883.)—More anti-vaccination juggling with statistics! Mr. Wheeler gets hold of one table of mortality and finds that ten years of least small-pox had more deaths than ten years of most small-pox; and then of another, showing that ten years of most small-pox had more deaths than ten years of least small-pox; but they all (according to him) prove the same thing! We all remember how Bret Harte took the number of people who were annually killed on railways and the number of those who died in their beds, showing conclusively that it was almost indefinitely safer to travel by rail than to go to bed. The anti-vaccinationists appear to us to deal with their statistics on a strictly cognate principle.

Solar Physics. An Almanack of the Christian Era, &c. By A. H. SWINTON. (London: W. H. Allen & Co. 1883.)—After wearily wading through this curious muddle of science and non-science (or, more shortly, nonsense) in its gorgeous cover, whereon a sun like a gilt crumpet reposes on an azure ground, we found that it concluded with a "list of subscribers." This, at all events, sufficed to explain the otherwise incomprehensible fact of its ever having been published at all. Our idea, gathered from its perusal, is that the author is a perfectly sincere and conscientious fanatic, who has been patted on the back by what has been not too politely called "the sunspot ring," in this country, for the sake of the respectability shed upon their professed views by their proclamation by a disinterested person. At all events, he quotes from a contribution of his own to the organ devoted to the pecuniary advancement of the gentry referred to. But he really ought to be right in his facts. To begin at the beginning, he sets down 1882 as the year of maximum sunspots, whereas the Astronomer Royal (on p. 8 of his "Report to the Board of Visitors of the Royal Observatory Greenwich, read on June 7, 1884), says:—"The mean spotted area of the sun was slightly greater in 1883 than during the preceding year." So, again, with his allegation (p. 46) that years of Sunspot Maxima are those of the greatest rainfall: Can his friend, Mr. Symons (p. 70), give him no information on the British rainfall during 1883 and 1884? The argument on pp. 61 and 62, however (if it can be dignified by that name), is perhaps as typical of our author's reasoning capacity as anything he advances. "Mr. F. Chambers," we are told, "has stated that when the sun is most spotty, then the mean yearly pressure on the barometer at Bombay is least; while at St. Petersburg, from 1822 to 1871, the mean height of the barometer is said, contrariwise, to have accorded with the spottings of the sun. . . . . Certainly the spots affect the barometer" (!) This "certainly" is delicious, and strongly suggests the dialogue in the immortal street drama of *Punch.* "About six weeks ago," says the original owner of Toby, "I lost this dog." "And," responds Mr. Punch, "about six weeks ago I found him." "Well," says his interlocutor, "that shows he's mine" "No," says Punch, "that shows he's mine." Is not the parallel perfect?

The Student's Guide to Scientific Botany. By ROBERT BENTLEY, F.L.S., &c. (London: J. & A. Churchill, 1884.)—We have one fault to find with Mr. Bentley's excellent little book, and that is the absence of a glossary of botanical terminology from its pages. But for this, it would be as invaluable to the beginner as it now is to the advanced student. Under existing circumstances, the incipient botanist who was struggling to identify one of (say) the Liliæ might rather fail to ascertain whether the specimen under investigation had its "Anthers introrse" and its "Fruit a loculicidal capsule," in the absence of any idea what "introrse" and loculicidal" could possibly mean? If, however, we conceive him to have mastered these and cognate terms, he could hardly possess a handier or more useful companion in his rambles in search of plants than the work before us. As the majority of the illustrations are taken from British medicinal plants, this small volume would seem to have been chiefly written as a text-book for the botanical examination of medical and pharmaceutical students; but any one who, by the aid of Mr. Bentley's book, will honestly work through the various genera of plants he describes must assuredly obtain a sound and comprehensive knowledge of the principles of systematic botany, to whatever purpose he may ultimately apply it.

Wonders of Plant Life under the Microscope. By SOPHIE BLEDSOE HERRICK. (London: W. H. Allen & Co., 1884.)—This pretty and pleasantly-written volume deals with some of the more remarkable facts in structural and physiological botany, and is well calculated to create, or strengthen, an interest in plant-life, and to invite attention to the marvels which it presents. We note one or two trivial errors in points of detail, but none of sufficient importance to detract from the value of a delightful book. Assuming that the object of its fair authoress has been to make the study of plants attractive, assuredly she has succeeded.

Confessions of an English Hachish-Eater. (London: George Redway, 1884.)—Accepting the recorded experiences of the author of this work as genuine, they present a certain amount of interest to the toxicologist and psychologist. By taking tincture of hemp he appears to have induced a sequence of wild waking dreams and nightmares, which he sets forth in somewhat rhapsodical language. Fortunately we find it hard to conceive that he will make many converts to his peculiar method of intoxication—at all events, in this country.

ON page 8 of the "Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory at Greenwich," presented at the Annual Visitation of the Royal Observatory, June 7, 1884, we read that "The mean spotted area of the sun was slightly greater in 1883 than during the preceding year." Hence it is pretty obvious that 1883 was the year of sun-spot maximum of the current cycle. Turning now to p. 34 of the "Results of the Meteorological and Magnetical Observations for 1883," at Stonyhurst College Observatory, we find Father Perry saying that "The rainfall for the year was nearly two inches below the average" (for the last thirty-six years). Certain members of a remarkable association at Brompton, known as "The Committee on Solar Physics," are now tired of assuring the uninstructed and unscientific public that years of maximum sun-spots are invariably those of maximum rainfall too; and that it is only necessary to pay sufficiently highly to have the one watched to enable the other to be predicted. It is as well that the real truth should be known in this matter before the National Exchequer is further called on to subsidise those who make such baseless assertions.

XUM

THE FACE OF THE SKY.

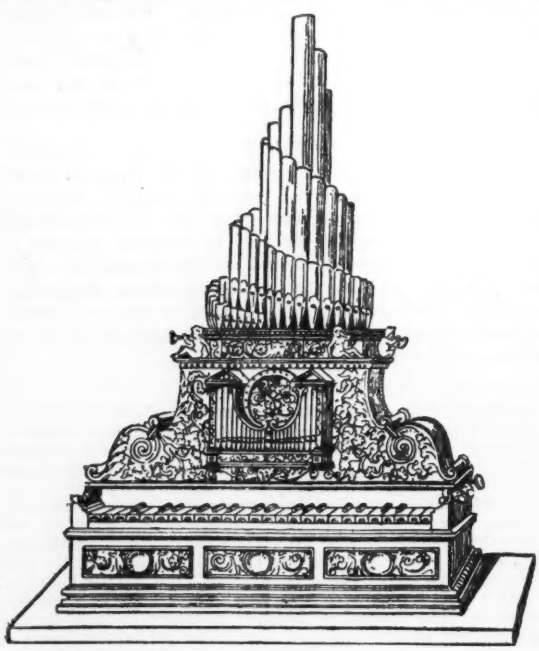
FROM JULY 18TH TO AUGUST 1ST.

BY F.R.A.S.

SUN-SPOT activity, albeit somewhat subsiding at last, continues sufficiently to render the Sun an interesting object of daily examination. Map VII. of "The Stars in their Seasons" furnishes the present aspect of the night sky. Mercury is an evening star, but by no means well placed for the observer. Venus is a morning star, and may be seen before sunrise with the naked eye. To the student who possesses the means of directing a telescope on her during the daytime, she will appear as a lovely object. These are the two solitary planets now visible. The Moon will scarcely come into view for the purpose of the ordinary observer until about the 27th, being New 54 minutes after noon on the 22nd, and travelling southward in the sky. One occultation of a star only will be visible during the period covered by these notes. It occurs on the 27th, when the 6½th magnitude star, B A C 4,294, will disappear at the dark limb of the moon at 8h. 16m. p.m. at an angle from her vertex of 164°, and reappear at her bright limb at 8h. 50m. p.m. at a vertical angle of 229°. The Moon is in Taurus to-day at noon, and remains in that constellation until 6 a.m. on the 20th, when she passes into the northern part of Orion. This she traverses in, as nearly as may be, 12 hours, entering Gemini at 6 o'clock in the evening of the same day. She does not leave Gemini for Cancer until 6 a.m. on the 22nd, and, oddly, it is 6 p.m. on the 23rd when she crosses the boundary into Leo. At 9 p.m on the 24th she descends into Sextans, emerging into Leo again about 9h. 30m. the next morning. At 11 a.m. on the 26th she enters Virgo, a constellation which she does not quit for Libra until 7 p.m. on the 29th. She is crossing Libra until 9 o'clock at night on the 31st, at which instant she passes into the narrow northern strip of Scorpio. Her path over this is traversed by 7h. 30m. the next morning, when she emerges in Ophiuchus. There we leave her.

DESIGN FOR PARLOUR ORGAN.

OUR engraving shows a design of an organ made many years ago, in which all the pipes are said to have been made of silver. We present it to our readers with the hope that it may



serve as a suggestion leading to the production of something new and good in the form of musical keyed instruments. We are tired of the present stereotyped shapes of our pianos and organs. Will not somebody strike out in a new direction? A suitable design of so novel and popular a character that people must have it would be worth many thousands of dollars to the manufacturer who secured it.—*Scientific American.*

Miscellanea.

THE Royal Microscopical Society, after careful deliberation, have decided upon admitting ladies to all the privileges of fellowship, attendance at the ordinary meetings excepted.

A CORRESPONDENT, writing anent a paragraph which appeared in p. 37, says that there must be some mistake in it, inasmuch as both the astronomical Doctors Draper, father and son, are, unhappily, dead.

To get rid of the smell of paint, plunge a handful of hay into a pail of water, and let it stand in any room newly painted. The smell will be greatly lessened.

IT is stated that the gas sold in the metropolis continues to increase, the quantity in 1883 being more than 20,000 millions of cubic feet. The quantity is vast, and the consumption of coal is proportionate, the weight carbonised being more than 2,000,000 tons.

AN article on "Patent Medicines" appears in our contemporary the *Lancet* for July 5, which may be perused with advantage by all who labour under the delusion that the Government stamp affords the slightest security against even the poisoning of the purchaser of any advertised nostrum.

IN 1882 the colony of Victoria was required by the courts to pay £120,000 to persons injured by accidents on the States railroads, of which it had 1,355 miles. The sum was 17 per cent. of the total net earnings of its railroads. Most of these accidents were on one comparatively short line, and the payments for injuries exceeded the net earnings of this line by about £25,000.

THE following quantities—in tons—of zinc were produced in 1883, by the different countries named:—The Rhine district and Belgium, 123,891; Silesia, 70,405; Great Britain, 27,661; France and Spain, 14,671; Poland, 3,783; Austria, 2,870; United States, 32,790; totals, 276,080. These figures all show increase on previous years, except as relates to France and Spain and to Poland, which show a decrease.

SIR LOUIS MALET, late Under Secretary of State for India, Sir Evelyn Baring, late Minister of Finance in India, and Mr. Westland, Comptroller and Auditor-General to the Government of India, have addressed a letter to Mr. Henry Dunning Macleod to be forwarded to the Civil Service Commissioners, earnestly recommending that his works on Political Economy should be adopted in the Civil Service examinations.

SOME time since, Dr. Morris, of Birmingham, succeeded, as he believed, in photographing a third sort of blood corpuscle, which, being of the same colour and the same refractive index as the liquor sanguinis, was invisible to the eye. Grave doubt has been thrown on the objective existence of these corpuscles by Mr. St. George St. Clair, who, as the result of a series of experiments, has, he conceives, demonstrated that Dr. Morris's corpuscles are nothing but photographic ghosts.

IT is estimated that the total annual production of watches in Switzerland at the present day exceeds 1,600,000, with an aggregate value of 88,000,000 francs, the total number of workmen employed averaging 40,000. A novel kind of watch has been recently invented by Mr. Paul Kramer, at Neuchâtel. This watch is called *à aiguilles universelles*, and indicates simultaneously the times of different countries; one, for example, shows the different times for Paris, Suez, Bombay and Hué, another for New York and San Francisco.

THE Anti-Vivisection Society have lodged a protest against the crucial experiment by which M. Pasteur proposes to demonstrate the efficiency of his vaccine for rabies. Mrs. Kingsford, M.D., who made herself prominent on this occasion, exclaimed that M. Pasteur was not justified in "torturing thousands of animals" with the object of abolishing so "very rare" a disease. The "thousands" when translated into the language of sober reason shrink to forty! As for the "rarity," we must remember that twenty-one persons died of hydrophobia in the Department of the Seine within twelve months.—*Medical Press and Circular.*

A DEPUTATION from the City Commissioners of Sewers visited Wimbledon recently to see the result of the experiments in electrical street lighting which have been conducted for some months past by Mr. Preece. From these it appears that the most efficient

practical mode of distributing light for a main street, like that of Wimbledon, is by means of 50-candle lamps, fixed 20 ft. high, at intervals of 100 ft. The effects were admitted to be remarkably striking, and to furnish a capital example of efficient street lighting. We hear that it is within the range of probability that similar experiments will, ere long, be tried in some of the busier City thoroughfares where arc lights, although not a failure, have apparently fallen short of their anticipated success.

ELECTRO-MAGNETIC INDUCTION.—At the Physical Society recently Mr. C. V. Boys exhibited the phenomenon first observed by Faraday, that a copper disc suspended bifilarly between the poles of an electro-magnet, so as to cross the lines of magnetic force at an angle, is suddenly kicked or twisted parallel with the lines of force when the magnet is excited. If the disc be perpendicular to the lines of force it is repelled by a pole when the magnet is made and attracted by the same pole when the magnet is unmade. Mr. Boys has investigated the phenomenon very fully, and points out that it offers a quick and ready means of measuring the intensity of an electro-magnetic field, as well as a means of finding the electric resistance of plates and discs of metal.—*Engineering*.

MR. CHARLES BATCHELOR, who has been engaged in developing the Edison system in Europe, states that the contracts on hand at the factories on the Seine are more than the 400 *employés* can carry out at present. Mr. Batchelor proceeds:—"The French company is completing a 20,000 light circuit for Paris. It covers the very heart of the city, the Rue de l'Opera, and other points which have heretofore been unsuccessfully attempted to be covered, by the best class of arc lights. The company has lighted already the Hôtel de Ville, and has over 6,000 lights in the Grand Opera House, 2,000 in the Eden Theatre, 1,200 in the Comique, 1,200 in the Vaudeville, and 1,200 in the Grand Hotel. Mr. Batchelor thinks it a fair estimate to say that the contracts of the company now cover about 26,000 private lights to which no power is furnished, but only the globes, &c. There are 600 lamps in La Nouveauté, 500 in La Variété, 500 in La Bouffe Parisenne. They are to be found in all the *cafés* from the Madeleine to the Variété, and as far north as the Gare St. Lazare, and as far south as the Hôtel Continental. Through all this district, the most important in the city, the company has the option of the right of way for all private lighting purposes on the payment of two and a half million francs, and its rights are guaranteed by the Government.

AT the meeting of the Geological Society, on June 25, the following communication was read:—"Additional Notes on the Jurassic Rocks which underlie London." By Professor John W. Judd, F.R.S., Sec. G.S. Since the reading of the former paper on the subject (Feb. 6, 1884), the well-boring at Richmond has been carried to a depth of more than 1,360 ft. The point reached is, reckoning from Ordnance-datum line, 220 ft. lower than that attained by any other boring in the London basin. A temporary cessation of the work has permitted Mr. Collett Homersham to make a more exact determination of the underground temperature at Richmond. At a depth of 1,337 ft. from the surface, this was found to be 75½° Fahr., corresponding to a rise of temperature of 1° F. for every 52·43 feet of descent. The bore is still being carried on in the same red sandstones and "marls," exhibiting much false-bedding, which were described in the previous communication. The Rev. H. H. Winwood, of Bath, has had the good fortune to find the original fossils obtained by the late Mr. C. Moore from the oolitic limestone in the boring at Meux's Brewery in 1878. A careful study of these proves that though less numerous and in a far less perfect state of preservation than the fossils from the Richmond well, they in many cases belong to the same species, and demonstrate the Great Oolite age of the strata in which they occurred.

THE DESTRUCTION OF WILD BIRDS IN INDIA.—Under the auspices of the East India Association, a meeting of naturalists, planters, sportsmen, and others interested in the affairs of India wes held on Friday, July 11, at the rooms of the Zoological Society, under the presidency of Professor Flower, LL.D., F.R.S. (Director of the British Museum Natural History Department, and President of the Zoological Society), for the purpose of urging the necessity of Government measures for the preservation of wild birds in India. The principal address was delivered by Mr. Robert H. Elliot, sometime planter of Mysore, and a well-known writer upon Indian topics. He pointed out that every civilised Government, with the exception of that of India, has recognised the value of birds as insect eaters, and has adopted measures for their preservation; and that the absence of legislation forebodes, where it has not yet presented, serious results to planters and agriculturists. As the most convenient season for the destruction of birds is during the fine weather that succeeds the heavy rains of the monsoons, and as this season is also the breeding time, the destruction of insect-eating birds proceeds at such a rate as must soon lead to almost absolute extermination, unless preservative measures are speedily adopted. There was a general agreement in the meeting that legislation on the subject is imperatively required, and it was resolved that a representation to that effect should be addressed to the Government of India.

BIRDS CAUGHT AND KILLED BY THE ELECTRIC LIGHT.—A despatch from Winona, Minn., describes a very curious incident in connection with the use of the electric light there. It says:—Every night this week thousands of migratory birds have gathered about the electric light on the stand-pipe in this city. Between the hours of one and two o'clock the birds were seen in swarms about the light, and hundreds fell to the ground. A few were caught alive, but the larger part were dead. Prof. Holzinger, of the normal school, reports the following species among those collected during the past two nights at the waterworks:—Catbirds, grossbeaks in variety, scarlet ranagers, golden crown thrushes, water thrushes, chestnut-sided warblers, blackburnian warblers, Tennessee warblers, magnolia warblers, Carolina rails, yellow-throated vireos, black and white creepers, traels, fly-catchers, green-crested fly-catchers, Savannah sparrows, white-throated sparrows, Maryland yellow-throats, black-billed cuckoos, helldivers, indigo birds, and yellow-bellied woodpeckers. On Tuesday night the grossbeaks predominated, and on Wednesday night the rails. Catbirds were numerous on both nights. The birds which breed in this locality were noticeably absent. Valuable additions from these birds are being made to the museum of the Society of Arts and Science, and a set of duplicates of most of the varieties has been furnished by Prof. Holzinger to the high school collection. Many of the birds which were caught alive may be seen in cages at the engine-house of the waterworks. —*Electrical World* (New York).

IT has been stated that the *Times* of June 14 is the largest production that has ever issued from the daily press with the exception of the *Times* for June 21, 1861. We, therefore, have pleasure in drawing attention to the following:—The *Times* issued June 14 consisted of twenty-four pages, each containing six columns—144 columns in all; the total length of which was 264 feet—52 feet higher than the monument; and they contained enough matter to fill two volumes of 480 pages. Almost every week, at least one issue of the *Daily Detroit Free Press* consists of twenty-four pages of seven columns each. On June 2, 1878, it consisted of thirty-two pages of seven columns each. On June 8 this year, in celebration of its removal into the new Free Press Building, Detroit, and on or about its fifty-third birthday, *The Daily Detroit Free Press* consisted of thirty-six pages of seven columns each—the largest paper ever printed in the world, we believe. This gives 252 columns, whose total length is 420 feet —double the height of the Monument, and sixteen feet to spare. The paper used to print this edition, run off the reels in a straight line, would extend 108 miles; while, spread out wide, it would cover 25 acres; piled sheet on sheet, as folded, it would tower up nearly three times the height of the Monument; and, in book form, it would fill two volumes of 600 pages each. The mechanical work —composing, stereotyping, and printing—occupied 148 men; and the literary matter, outside the reports of the Associated Press, was furnished by no less than thirty-five editors, reporters, and regular contributors attached to *The Free Press* staff, and forty-two correspondents in various parts of the world. The price was five cents, as usual.

COLOUR-BLINDNESS.—There is every reason to believe that the new apparatus for combining colours, devised by Mr. Offert and by Lord Rayleigh, will lead to a thoroughly scientific investigation of colour-blindness. Considering how common Daltonism is, and how essential it is that railway men and others working with coloured signals should be free from it, or at least know the extent to which they suffer from it, some simple means of investigating it is desirable. Lord Rayleigh's apparatus is based on double refraction, and the obtaining of two overlapping spectra, which the person under examination looks at, and describes as green, blue, or purple, whatever it appears to his or her sight. Lord Rayleigh has, we believe, tested the vision of numerous friends, and is willing to extend his observations further. So far he has found that the majority of persons tried require only half as much red in the mixed spectra to turn a given yellow into green as he himself does. People vary from each other in matching colours, and there are grades of "colour-blindness." Ordinary colour-blindness is blindness to red, but the father of Mr. Stanley, the optician, was colour-blind to green. As an engineer, when engaged in colouring plans, he had to single out his green pigments by their names. To him they appeared a kind of brown. Lord Rayleigh has not, we understand, noticed any striking differences between the two eyes of the same person, except what is due to fatigue of one eye and freshness of the other. Dr. Guthrie, who is colour-blind to red, believes himself more than usually sensitive to blue; and Lord Rayleigh has found persons abnormally sensitive to red, as well as abnormally insensitive to it. It would be interesting to discover whether such

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persons can see further down the red end of the spectrum than is usual. Perhaps the modification of Lord Rayleigh's apparatus, by Mr. Glazebrook, for measuring the distance on the spectrum, which any one can see, will answer this part of the inquiry.—*Engineering.*

FIREPLACES.—Now is the time to embellish the fireplaces. But what are we going to choose, floral decorations or paper? Let us hope not the latter, for nothing shows the want of good taste so much as when one enters a room, and is immediately faced by an array of red tinsel, or some such fiery stuff, to hide the empty grate. Therefore we will put paper out of our thoughts, and seek some other more suitable subject. Plants are exceedingly ornanamental, that is, when nicely arranged. But then the question arises, What have we got suitable? Palms, grasses, dracænas, ferns, are excellent, the point being to secure plants with neat and graceful foliage. Then we shall want a fair proportion of colour to light up the group. For this purpose the flowers should be choice as well as showy. A huge geranium or pelargonium placed in the centre of the grate is decidedly unsuitable, because it betrays bad taste. A neat tuft of white Marguerites peeping out from amongst grassy leafage will be decidedly preferable to a large lumpy calceolaria or geranium. The plants will want renewing constantly, because it does not look well to have sickly plants in such a prominent position. It is customary with many to fit a mirror to the entire opening of the fireplace, and then group the plants in front; this produces a fine effect when the plants are nicely arranged. It is necessary that the plants are clean and dry when placed in position, but the soil in the pots should be moist enough to last a few days. If the plants are not kept too long in the parlour, they will be none the worse for the change.—*Amateur Gardening.*

INTRODUCTION OF THE ELECTRIC LIGHT AT MR. J. F. MILNER'S FLOUR MILL.—A short time ago, a description was given in the *Guardian* of the new system of grinding corn by the roller process introduced by Mr. J. F. Milner at his Woodside mill. Mr. Milner has now introduced the method of electric lighting at his premises, so that the Woodside mill is now one of the most complete premises for corn grinding to be met with in the north of England. As the mill is run day and night, the introduction of electric lighting will, it is believed, prove to be an immense advantage in many ways. The experiment was tried for the first time on Thursday night, and was found to work admirably, the lamps giving out a clear, steady, and brilliant light. A brief description of the working will be of interest to many readers. The installation consists of one Crompton Burgin compound self-regulating dynamo-machine, and some seventy-six 20-candle power Swan incandescent lamps. The machine, however, is capable of supplying some ninety such lamps, and it is intended to add to the number on the completion of Mr. Milner's new offices. It is also intended that there shall be an arc lamp on each side of the mill, for loading purposes; these will be of the well-known Crompton Crabbe double differential type, of 2,000 actual candle-power. The Crompton Burgin machine is now so well-known that we need not again go into its details; suffice it to say that any number of lamps can be turned out without affecting the remainder, and that the power absorbed is diminished in proportion thereto. The Swan lamp, too, is noted for its durability and economy, and has long been recognised as one of the best in the market. The machine is placed on the top floor, where it is driven by a small separate engine, which, although intended to drive the hoist, answers admirably for driving the lights, as it can always be kept running if desired. It is driven by a countershaft, at a speed of 1,400 revolutions per minute. Near the dynamo is a neatly-polished pitch pine switch-board, containing three main switches, which convey the current to the mill, warehouse, screens, &c., respectively. We may here remark that a very ingenious arrangement has been tried in regard to the staircase, whereby all the lights on the landings can be left burning when the others are turned out, thus enabling any one to see his way down the steps after turning out the lights in his own room. On the switch-board are also a pair of fusible cut-outs (Hedge's patent), which serve the same purpose as a fusible plug in a steam-boiler. There are also small cut-outs to each lamp, so as to prevent the possibility of fire from any cause whatever. The question of reducing fire-risk in corn-mills is especially interesting. The loss by fire in corn-mills has increased from £42,000 in 1877 to £154,000 in 1883, and this has resulted in the insurance companies raising their rates of premium. The adoption of the electric-light, however, will, it is believed, be a great step towards reducing this risk to a minimum, and it is hoped that ere many months have passed, the insurance companies will recognise its advantages, and reduce their present high rates. The work has been carried out under the superintendence of Mr. J. T. Baron, on behalf of Mr. Wilson Hartnell, electric-light contractor, of Leeds, who recently lighted up the new mill of Messrs. James Clay & Sons, Luddenden Foot.

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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"THE PROPHET OF SAN FRANCISCO."

[1339]—I fear I am asking more than I ought to ask of your kind indulgence by begging you to insert such a letter as this, referring, as it does, to a review you were so good as to give in your last number of my pamphlet—"The Unlimited Debt;" but I cannot help feeling that some injustice has been done me by your calling me "a disciple of Mr. George's," without stating that I differ from him in a very important particular, by disapproving of confiscation.

Secondly, you say that if rent took the place of taxes, "God help the cultivator of the soil;" but the whole point of the question is this:—If private property in land is unjust, then that largest of all classes, the poor—including the poor of the towns and the labourers of the country—are those whose case calls most for pity. If the land belonged to the State, they, as part of the State, would benefit by rent; now they have none of it.

As for the tenant, the object of your pity, it must not be forgotten that he also has now no share of rent, and that he would under the State system have, in addition to his share of rent, the protection of a court of law corresponding exactly to the Irish Land Commission, which has, in fact, been called into existence owing to the necessity of protecting him from the exactions of *private owners*. It was obviously impossible for me to provide against all possible objections within the short compass of a threepenny pamphlet, I am therefore the more emboldened to beg the insertion of this letter.—I am, sir, your faithful servant,

F. W. D. MITCHELL.

[I have yet to learn that the Irish Land Commission has proved such a success as to invite its reproduction in any other country in the civilised world.—ED.]

MEALWORMS.

[1340]—In consequence of absence of home, I missed seeing the number of KNOWLEDGE containing F. M. Duplock's inquiry as to mealworms, and only came across it for the first time a few hours ago, when looking through some back numbers. I trust Mr. Duplock will accept this explanation as my apology for the delay in replying to his courteous letter.

I fear an article on mealworms is impracticable at present, but perhaps the following notes may be useful. Mealworms are the larvæ of two kinds of elongate blackish beetles, *Tenebrio molitor* and *T. obscurus*, which are the only British representatives of the genus. They closely resemble one another in general appearance, but the latter, which is usually a little the larger of the two, may be at once distinguished by its duller appearance. It is said that the mealworms from the East-end of London are generally those of *T. obscurus*, and those from the West, *T. molitor*. The beetles may be found in bakeries, flour-mills, granaries, &c., where they devour anything farinaceous they can get hold of.

They are noted also for the depredations they commit on ship-biscuits. They occasionally fly to gas-lamps like moths. The larvæ of the two species are also much alike, that of *T. obscurus* being somewhat darker in colour, and having the terminal segment rather longer. They are said to live two years in the larval state, and then, without forming a cocoon, change to a pupa which displays the form of the future beetle, and is probably the

"tiny ghost," and "corpse-like thing" referred to, though on this point we can scarcely speak definitely in the absence of a more accurate description. The pupa state usually lasts about six weeks, but its duration would be largely dependent upon temperature. The beetle, on emergence from the pupa, is soft and of a reddish colour, but, after a while, hardens and darkens.

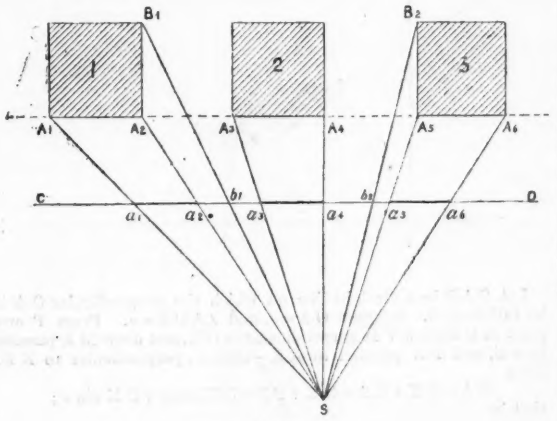
The query as to variation in size and growth of perfect insects will be found answered in KNOWLEDGE, No. 138, p. 450. Sex and differences in quality and quantity of food are the principal factors in producing differences in size. Amongst beetles, this variation is greatest in those that feed on solid wood. E. A. BUTLER.

7, Turle-road, Tollington-park, N.

TRUE AND FALSE PERSPECTIVE.

[1341]—A perspective drawing of an object may be defined as any section of a sheaf of rays of light proceeding from that object to a given point, at which the eye may be placed.

If the section be correctly made, the perspective drawing is absolutely true in all cases, and on the application of the eye to the apex (*i.e.*, the given point) of the sheaf of rays the representation on the section has precisely the appearance of the object; or if the representation be made opaque it will exactly hide the object from the eye. If we decide on making a vertical plane section of the sheaf of rays parallel to the face of the object, that decision becomes the governing element in the problem.



Ground Plan.

In the accompanying diagram 1, 2, 3 are ground plans of cubes. The spaces marked A1, A2; A3, A4; A5 and A6, are equal to each other; the sides A, B are also equal. To the point S lines are drawn from all the angles of the cubes, which would be seen on placing the eye at S. These lines may be called the leading lines of light from the objects to that point. The *section* line C, D is *parallel* to the *object*, as decided.

The spaces on the section line marked *a*1, *a*2; *a*3, *a*4; and *a*5, *a*6 are equal to each other in the section as they are in the objects. It is evident that on placing the eye at S the space at *a*1, *a*2 will exactly cover the space A1, A2. All the other spaces of the section will exactly cover all the corresponding spaces of the objects in like manner, and if we make them opaque they will hide the spaces of the ground-plan and *stand for them*.

What has been demonstrated of a ground plan is equally true of a vertical section. JOHN BACON.

STRANGE SKY EFFECTS IN NEW ZEALAND.

[1342]—I have just received a letter from a young niece in New Zealand, dated May 20. She writes from near Christchurch, Canterbury:—"We have been having the strangest weather lately, and such curious skies for some months past. The other morning, about 11 a.m., I looked out towards the east, and the sky was all golden and crimson as if it were sunset, as if the sun had made a mistake and was going to bed at the wrong time and in the wrong place. At night, we have the most lovely, rosy lights in the sky; but, beautiful as the skies are, and much as one admires them, they seem to give one a sort of uncanny feeling as if something were going to happen." COSMOPOLITAN.

LETTERS RECEIVED AND SHORT ANSWERS.

SENECA. If you are going to try to teach yourself French, probably the "French" in Prendergast's "Mastery Series" is as good a book as you can get.—FOREIGNER disagrees with Délille's classification of "mon," "ton," "son," with "le mien," "le tien," &c. —W. Thanks; marked for insertion.—EDWIN W. MORRIS and A. MACKAY. I regret to say that I have been compelled to relinquish lecturing entirely—at all events for a considerable time to come.—M. B. Obviously a misprint, the figures being transposed.—H. G. has found some earwigs in strawberries! Well, they are not pleasant to look upon; but, doubtless, in the words of the poem, they are "nourishing, very." W. C. B. demurs to the idea that a polluted river is necessarily unwholesome, as over and on the banks of one—"a mass of festering filth, chocolate in colour, molasses in consistency, and of stench simply indescribable"—many of his workpeople live hale and hearty, as did he and a large family for fifteen years. Moreover, twenty cows, always well and thriving, drink this filth in preference to pure spring water. Just so; *de gustibus non est disputandum!*—F. W. D. MITCHELL. Your pamphlet was reviewed on p. 36.—J. P. BOURNE sends me a "Handy Assurance Guide," consisting of a tabular mass of statistics having reference to ninety-five of the principal insurance offices in the kingdom. Intending assurers can gather the position and prospects of any one of them from it at a glance.—E. D. WAREING saw his own ghost in bright sunshine in 1882, and wants to know whether the comet of that year had a disturbing effect upon light? Unless comets make people light-headed, I should say, no. He further opines that the brain is affected by light, the heart by electricity, and the lungs by oxygen, and that the difference in the shape of light (!) would make the distinction between man and beast, &c. "I have written," says my correspondent, "all this very diffidently, feeling not quite sure whether you may not think it great nonsense." Which—in the most sacred confidence—I don't mind admitting to him that I do.—ARTHUR A. WEST. Having adopted my suggestion (on p. 16) as to drawing the outline of a cube placed behind, and with one face parallel to, a sheet of glass, finds that, under the prescribed conditions, "the top and bottom margins of the face are parallel." His two remaining figures I fail to understand, as one represents a sketch made "on glass facing the centre of the cube" (what is the *visible* centre of a cube?), and the other "on glass placed facing away from the cube." This is delightfully vague.—W. A. COOPER. You may turn the telescope you wish to test upon the following objects:—ζ Herculis, λ Ophiuchi, τ Ophiuchi, π Aquilæ, ψ Cygni, 49 Cygni (2° south-west of ε), δ Cygni, in twilight only. The ring Nebula between β and γ Libræ, and see if you can see the small star close to and to the east of it. The companion to Vega, ε^1 and ε^2 Lyræ, in connection with which try how many stars you can see between the two principal pairs. If the instrument resolves all these tests satisfactorily, buy it.—H. A. BULLEY. When "F.R.A.S." speaks of a planet as "visible," he means visible for the purpose of the observer with the telescope. Perhaps you will kindly look at Mars (subtending, as his diameter now does, an angle of less than 6″), and tell us how much detail is visible on his surface, and in what material respect—saving in the exhibition of a rather larger disc—his aspect differs from that of Antares. Mercury is a totally different object, because he is essentially a daylight star, and, under your suppositious conditions, would exhibit phases.—H. G. S. It is quite news to me that the erratic genius to whom you refer was an excellent mathematician. But even assuming this to be true, with my present tremendous amount of preoccupation, I certainly cannot spare the time to expose the fallacy of a mere assertion of his, so transparently erroneous, and, moreover, unsupported by the slightest attempt at demonstration.—M. R. Do you seriously expect me to wearily puzzle out the numerical value of 55 figures in succession, with the thermometer standing at 84·4 Fahr. in the shade?—ALFRED EDWARD HUNT. Everybody upon the earth, *ex necessitate*, partakes of the earth's motion, which affects it utterly irrespective of any other motion that may be impressed upon or imparted to it. The next time you are in a railway train going 50 miles an hour, drop any object from a point immediately beneath the lamp-glass, and you will find that it will fall vertically beneath that glass on the floor of the carriage, although the carriage has meanwhile moved perceptibly forward. Read Tomlinson's "Rudimentary Mechanics" in Weale's Series.—J. A. R. Have I not said, over and over again, that I must rigidly exclude theology from these columns? If I admit such a letter as yours, and (say) Dr. Aveling or Mr. Bradlaugh were to reply to it, upon what principle of justice could I refuse to insert their answers?—R. JONES, having made the experiment suggested on page 16, and finding the result in entire accordance with the views he previously advanced, offers to forward a proof of

the truth of them to Rosalie Vansittart and "An Old Draughtsman" privately, should that lady and gentleman desire it.—AN OLD DRAUGHTSMAN. Scarcely relevant to the general subject.—JOHN BACON. With the excisions rendered imperative by the wholly needless length of your letter, it has been marked for insertion. Thanks for your offer of an article; but original matter is provided for some time to come. Besides, you must pardon me for saying that you have yet to learn the art of writing briefly and to the point only.—JOS. LUCAS AND SON. I strongly urge you not to part with anything to the person you name, who is certainly an impostor. No member of our staff would be suffered (or, in fact, would condescend) to accept goods, that favourable notices of them might appear in the pages of KNOWLEDGE.—E. B. G. MCDOUGALL. Thanks, but none such of any importance reach me.—W. J. C. suggests that the experiment should be tried of artificially extending the wings of a dead bird and attempting to fly it like a boy's kite.—MAUDE LE BAILLE describes, at wholly inordinate length, how she succeeded in teaching a little girl to read who had previously defied the efforts of three or four governesses. Briefly she did so by first teaching her to write. The child was allowed to draw on her slate, as well as form letters and figures, the letters being later on combined into monosyllabic words. At this stage, to her own surprise, she found herself capable of reading a page of "Mamma's Lessons." No one but an editor would believe that this is told on nine pages and a half (!) of exercise paper.—WILLIAM SINGER. As is so perpetually the case with correspondents, the length of your letter forbids its appearance.—JAS. STANLEY LITTLE intimates that the reviewer of his book (on p. 12) was in error in supposing him (Mr. L.) to be an artist. He has never attempted to produce even the simplest drawing since he left school.—ST. E. There are but few works on "animal"—as contradistinguished from human—physiology. Probably Shea's "Manual of Animal Physiology," published by Churchills, would be as good a book as you could obtain.—REV. S. B. HANDLEY, and many other correspondents. As stated in my reply to Messrs. Morris and Mackay above, I have entirely ceased lecturing. Should I ever resume it, due notice will be given.—G. C. I should be very sorry to sleep myself, and assuredly would not suffer a child of mine to sleep, in a bedstead placed in the position indicated in your diagram during a heavy thunderstorm.—P. MACLEOD YEARSLEY sends an anecdote of a dog which, finding a piece of meat larger than it could eat, went to the very top of the house to fetch a lady down to cut it up.—WM. WILSON, M.A., LL.D. Your difficulty seems to arise from the omission by Colenso of the word "whole" before number. Other writers on arithmetic add this word. Of course, in one sense any number, whole or fractional, which divides two or more whole numbers exactly, is a common measure of them, and would be rightly so described.—THE SECRETARY OF THE NATIONAL SMOKE ABATEMENT INSTITUTION. I regret that absence from London prevented my attendance.—E. C. R. Atmospheric electricity presents to a great extent still an unsolved problem. It is, however, safe to assume that the electric force, which would otherwise cause a dispersion of the cloud particles, is feebler than the other forms of force which cause and maintain a condensation of the originally charged attenuated vapour particles. When the cloud charge attains a high potential, it doubtless experiences a strong tendency to approach the oppositely-charged earth surface bodily. The intervention of the air prevents this, and acting with the electrical attractions, the cloud is broken up. Probably the attraction exerted by the opposite charge on the earth prevents the breaking of the clouds in those higher regions where, under ordinary circumstances, the discharge of rain would commence, and eventually the drops assume larger dimensions.—R. G. T. Madame Blavatzky's trick of causing a bell to sound in the air may be bought at Hamley's, the Noah's Ark, Holborn; Bland's, New Oxford-street, or at any good shop where conjuring apparatus is sold; under the title "Is your Watch a Repeater?"—NORWICH. Many thanks for your kind and friendly letter. Gossip has been rather crowded out for a week or two.—THOS. MACLEAN. Believe me, I was *not* indebted to your suggestion for the idea of the gyroscope. It has been a familiar one to me long enough. ALEX. GUSTAFSON sends me a little pamphlet on the "Medicine Stamp Tax," which well illustrates the evils arising from the quasi-Government sanction given to all sorts of quack remedies.

In reply to numerous letters and communications addressed to the office of KNOWLEDGE, *its Editor begs to announce that he has now concluded his Lecturing Tour, and has, in fact, definitely ceased to lecture altogether. Should he (which is very doubtful) at any future time resume his lectures on Astronomy, due and ample notice will be given of such resumption in these columns.*

Our Mathematical Column.

EASY LESSONS IN CO-ORDINATE GEOMETRY.

BY RICHARD A. PROCTOR.

(*Continued from p.* 19.)

WE shall now present two forms of the equation to a straight line which are often found useful.

52. PROP.—*To find the equation to the straight line in terms of the perpendicular let fall from the pole upon the straight line, and the angle which this perpendicular makes with the axis of x.*

We have already seen (45) that the polar equation to the straight line in terms of p the perpendicular from the pole on the line and α the angle which this perpendicular makes with the initial line, is

$$r \cos(\theta - \alpha) = p \quad \text{(i)}$$

that is

$$r \cos\theta \cos\alpha + r \sin\theta \sin\alpha = p$$

but transforming to rectilinear co-ordinates we have

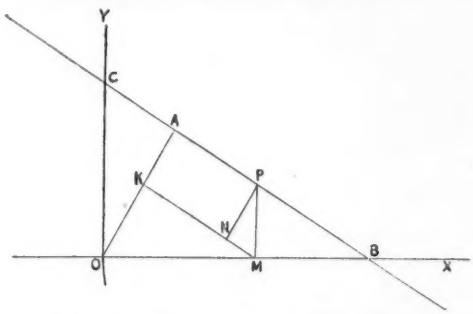
$$r \cos\theta = x \text{ and } r \sin\theta = y$$

thus (i) becomes

$$x \cos\alpha + y \sin\alpha = p$$

the required equation.

53. On account of the importance of this form of the equation to a straight line we add an independent investigation.



Let C A B be a straight line on which the perpendicular O A is let fall from O. Suppose $OA = p$, and $\angle AOB = \alpha$. From P any point in C B draw P M perpendicular to O X, and draw M K parallel to B C, and P N parallel to A K—that is, perpendicular to K M. Then

$$OA = OK + KA = OK + PN = OM \cos\alpha + PM \sin\alpha;$$

that is

$$x \cos\alpha + y \sin\alpha = p,$$

as before.

54. As an illustration of the mode of obtaining any one form of the equation to a straight line from another form, we shall show how the equation just obtained may be deduced from the equation.

$$\frac{x}{a} + \frac{y}{b} = 1 \quad \text{(i)}$$

in terms of the intercepts a and b.

In 53 (using the same figure) and

$$a = OB = p \sec\alpha; \text{ and } b = OC = p \operatorname{cosec}\alpha;$$

substituting these values in (i) we get

$$\frac{x}{p \sec\alpha} + \frac{y}{p \operatorname{cosec}\alpha} = 1$$

that is

$$x \cos\alpha + y \sin\alpha = p,$$

as before.

55. *Note.* It is necessary that the student should carefully observe in what manner equations of the form just obtained are to be interpreted. And first of the perpendicular p and the angle α, it is to be noted that a positive distance p is to be measured along a line inclined to OX at an angle α (measured as described in former articles. The required line is then to be drawn at right angles to the line thus obtained, through its extremity. Thus in the equation

$$x \cos\alpha + y \sin\alpha - p = 0$$

p is invariably a positive quantity.

56. To put the general equation

$$Ax + By + C = 0 \quad \text{(i)}$$

into the form just obtained, proceed as follows:—Divide each term by $\sqrt{A^2 + B^2}$ giving that sign to the radical which will make the constant term C negative. Thus (i) becomes

$$\frac{Ax}{\sqrt{A^2+B^2}}+\frac{By}{\sqrt{A^2+B^2}}+\frac{C}{\sqrt{A^2+B^2}}=0$$

in which the last term is negative. This is of the required form since

$$\left(\frac{A}{\sqrt{A^2+B^2}}\right)^2+\frac{B}{\sqrt{A^2+B^2}}^2=1$$

57.—The student will find it a useful exercise to transpose an equation to a fixed, straight line into the different forms we have been examining. He will find that when proper attention is paid to the directions in which lines and angles are measured, no difficulty can occur in interpreting the constants which appear in different forms of the equation. On one point comment is necessary. The angle which a straight line makes with either axis is not necessarily the acute angle between the line and that axis. Thus the line B C (B on O X, C on O Y) makes with O X is not the angle C B O but the angle C B X, since this is the angle through which a line coincident with O X would have to revolve in the positive direction, about the point B, to become coincident with C B. We might also say that the line C B is inclined to O X at a negative angle C B O, or at a positive angle $\pi+$C B X, or $2\pi+$C B X, or in fine, generally, at an angle $n\pi+$C B X where n is any integer positive or negative. This would in no way affect the interpretation of the particular equation involving this angle, that is of the equation

$$y=mx+c$$

where m is the tangent of the angle we are considering; since we learn from trigonometry that $\tan\alpha=\tan(n\pi+\alpha)$ whatever integral value n may have.

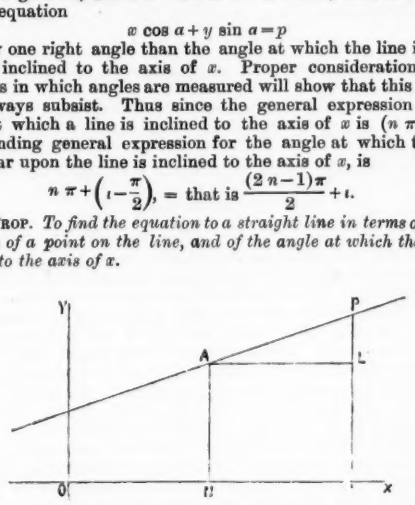
58. In Figure 53, $\angle AOB=\angle CBX-\angle OAB$; that is the angle α in the equation

$$x\cos\alpha+y\sin\alpha=p$$

is less by one right angle than the angle at which the line it represents is inclined to the axis of x. Proper consideration of the directions in which angles are measured will show that this relation must always subsist. Thus since the general expression for the angles at which a line is inclined to the axis of x is $(n\pi+\iota)$ the corresponding general expression for the angle at which the perpendicular upon the line is inclined to the axis of x, is

$$n\pi+\left(\iota-\frac{\pi}{2}\right), \text{ = that is } \frac{(2n-1)\pi}{2}+\iota.$$

59.—PROP. *To find the equation to a straight line in terms of the co-ordinates of a point on the line, and of the angle at which the line is inclined to the axis of x.*



Let A P be a straight line, passing through a point A whose co-ordinates are h, k. Let α be the angle at which A P is inclined to O X. Draw P M, A N parallel to O Y, A L parallel to O X. Then

$$\frac{PL}{AL}=\tan\alpha.$$

that is

$$\frac{y-k}{x-h}=\tan\alpha. \qquad \text{(i.)}$$

the required equation.

It may be noted that (i.) is clearly the equation obtained from the form $\frac{y}{x}=m$ of 30, by transformation of co-ordinates.

Equation (i) may be written into the form.

$$\frac{y-k}{\sin\alpha}=\frac{x-h}{\cos\alpha} \qquad \text{(ii)}$$

and since $\frac{PL}{AP}=\sin\alpha$, we have, putting A P = r

$$\frac{y-k}{\sin\alpha}=r=\frac{x-h}{\cos\alpha}$$

a mode of writing the equation which is often found convenient in practice.

60. OBLIQUE CO-ORDINATES.—The equations of forms considered in 57 to 59 can be readily obtained for oblique axes. Thus, if we suppose $\angle XOY=\omega$ and $\angle AOC\ (=\omega-\alpha)=\beta$ it would follow, as in 44, that

$$OA=OK+PN=OM\cos\alpha+PM\cos\beta$$

that is

$$x\cos\alpha+y\cos\beta=p$$

the required equation, in which $\beta=\omega-\alpha$.

In place of equation (i) of 59 we should clearly obtain

$$\frac{y-k}{x-h}=\frac{\sin\alpha}{(\sin\omega-\alpha)}$$

which may be written

$$\frac{y-k}{\sin\alpha}=r=\frac{x-h}{\sin(\omega-\alpha)}$$

(To be continued).

EASY RIDERS ON EUCLID'S FIRST BOOK.

WITH SUGGESTIONS.

(Continued from p. 41.)

174. In the parallelogram A B C D, the angle A D B is equal to one-third part of the angle A E B; also A C and B D intersect at an angle equal to one-third part of two right angles. Show that one of the diagonals is at right angles to opposite sides of the parallelogram.

175. If the angle between two adjacent sides of a parallelogram be increased, while their lengths remain unchanged the diagonal through the point of intersection will be diminished.

176. If two opposite sides of a parallelogram be bisected, the lines drawn from the points of bisection to the opposite sides trisect the diagonal.

177. If A B a side of the parallelogram A B C D be divided into n equal parts, show that a line drawn from C to the division point nearest to B cuts off from the diagonal B D one $(n+1)$th part,—measured from B.

Take for n *any convenient number—say* 7. *Divide* A B *and* C D *into* 7 *equal parts, and join* C *with the division nearest to* B, *the division nearest to* C *with the next division from* B *and so on. It will then be easy, in the manner of the preceding example, to show that any one of the* 8 *parts into which the diagonal is thus divided is equal to any other part—or, in other words, that the diagonal is divided into* 8 *equal parts.*

178. In the straight line A B C, A B is equal to B C. Show that perpendiculars drawn from the points A, B, and C upon any straight line meet it in equi-distant points.

(i.) When the line passes between A and C.

(ii.) When the line does not pass between A and C.

179. In case (ii.) of Example 178, show that the perpendicular from A and C are together double of the perpendicular from B.

180. In case (i.) of Example 178, show that the difference of the perpendiculars from A and C is double of the perpendicular from B.

181. If straight lines be drawn from the angles of any parallelogram perpendicular to a straight line which is outside the parallelogram, the sum of those from one pair of opposite angles is equal to the sum of those from the other pair of opposite angles.

182 Determine a point in the base of a triangle from which lines drawn parallel to the sides, to meet them, are equal.

183. If an hexagonal figure admits of division into three parallelograms each pair of opposite sides are equal and parallel.

Show that in general such an hexagonal figure admits of being divided into three parallelograms in two different ways.

184. If each pair of opposite sides of a hexagon are parallel, and one pair equal, the other pairs are also equal.

185. If each pair of opposite sides of a hexagon be equal and parallel, the three straight lines joining opposite angles will meet in a point.

186. If each pair of opposite sides of a rectilinear figure having an even number of sides be equal and parallel, all the lines joining opposite angles meet in a point.

187. Describe a rhombus within a given parallelogram, so that one of the angular points may occupy a given point on the perimeter of the parallelogram.

188. Describe a rectangle within a given parallelogram, so that one of the angular points may occupy a given point on the perimeter of the parallelogram.

In examples 187 *and* 189 *it suffices that the angles of the constructed figures should lie on the sides or the sides produced of the parallelogram. Previous examples show the relations which hold when a parallelogram is a rhombus or rectangular, and these will be found sufficient for the solution of Examples* 187 *and* 189.

189. The three sides of a triangle are together less than the three lines drawn from the angles to the bisections of the opposite sides.

Complete a parallelogram having two sides of the triangle as adjacent sides. Then show that these sides are together greater than the diagonal which passes through the bisection of the base, &c.

XUM

Our Chess Column.

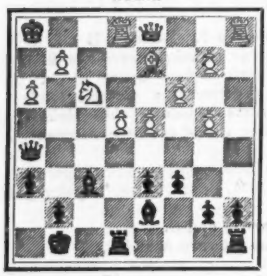
BY MEPHISTO.

PLAYED July 9 in the Handicap at the Divan. Remove Black's King's Bishop's Pawn.

	White. Mundell.	Black. Gunsberg.
1.	P to K4	P to Q3
2.	B to B4 (*a*)	Kt to KB3
3.	Kt to QB3	P to K4
4.	P to Q3	Kt to B3
5.	B to Kt3	Kt to Q5
6.	QKt to K2 (*b*)	Kt × B
7.	RP × Kt	B to K2
8.	P to KB4	P × P
9.	Kt × P	Castles
10.	Kt to B3	P to B3
11.	Castles	P to KR3
12.	B to K3 (*c*)	Kt to Kt5
13.	B to Q2	B to B3
14.	P to Q4	Q to Kt3
15.	P to B3	R to K sq.
16.	R to K sq.	B to Q2
17.	Kt to R5 (*d*)	B to K2
18.	P to R3	Kt to B3
19.	Kt × Kt	B × Kt
20.	K to R sq.	Q to Kt4
21.	P to QKt4	Q to KR4 (*e*)

Position after Black's 21st move.

WHITE.



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22.	B to B4	B to K2 (*f*)
23.	P to K5	P to Q4
24.	P to K6 (*g*)	QB to B sq.
25.	Kt to K5 (*h*)	Q to B4
26.	Kt to Q3	B × P
27.	P to KKt4	Q to B3
28.	R to K3 (*i*)	B to B2 (*j*)
29.	Q to K2	B to Kt3
30.	R to KB sq.	B to K5 (ch)
31.	K to R2 (*k*)	R to KB sq.
32.	R to B2 (*l*)	B × Kt (*m*)
33.	R × B	B to Q3
34.	R (Q3) to B3	B × B
35.	R × B	Q to Q3
36.	Q to K5	Q × Q
37.	P × Q	R × R
38.	R × R	R to K sq.
39.	R to B5	P to Kt3
40.	R to B6	K to Kt2
41.	R to Q6	K to B2 (*n*)

Position after Black's 41st move.

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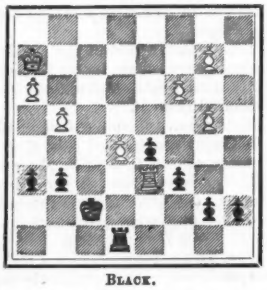

BLACK.

42.	R to Q7 (ch) (*o*)	R to K2
43.	R × R	K × R
44.	P to KKt5 (*p*)	P to KR4 (*q*)
45.	K to Kt3	K to K3
46.	K to B4	P to Kt3
47.	P to Kt3	P to R3
48.	P to B4	P × P
49.	P × P (*r*)	P to R4
50.	P to B5	Resigns (*s*)

NOTES.

(*a*) This can hardly be considered as good as 2. P to Q4.

(*b*) To disengage his Queen's side, and make both Knight's available for attack on the K's side.

(*c*) This move gives Black time to develope his pieces.

(*d*) If P to R3, then Kt to K4. Black has brought his pieces well into play.

(*e*) A very useful flank movement. The Queen now occupies a good position.

(*f*) With a view to playing R to B sq., which might give a chance for B × RP.

(*g*) Although tempting, this is weak, as the P will sooner or later be captured.

(*h*) If Black plays Q × Q. 26. QR × Q, B × P. 27. Kt × P.

(*i*) To guard against Q to R5, also to double his Rook on the K's file.

(*j*) To bring the B into good play.

(*k*) K to Kt sq. was the proper move.

(*l*) To guard against P to KKt4.

(*m*) Black now brings about the exchange of four pieces, remaining with a superior end position.

(*n*) If R × P White could equalise the game by playing R to Q7 (ch), followed by R × P and R to B7, &c.

(*o*) This is playing Black's game. White ought to have played R to B6 (ch), driving the K back again.

(*p*) A good move. It would be dangerous to take, as by K to Kt3 and Kt4 White would gain a decisive advantage.

(*q*) Now, of course, the game is virtually over, as White has but the one square on B4 to defend his KP, and when short of a move he will have to move his K.

(*r*) Now comes the most extraordinary part of the game, which should serve as a warning that a game is never won until checkmate is given. By playing P to B4 Black wins, as the Rook's Pawn becomes free to advance whether White replies with P × P or P to Kt5. Instead of winning the game on the move Black lost it on the move by hastily advancing the wrong Pawn without examining the consequences. Besides losing the well-earned victory in a hard fought game, Black loses all chance to play for first and second prize, although this is the only game lost out of eight games played.

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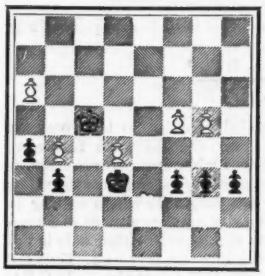

BLACK.

(*s*) The game is not to be saved if Black plays P to R5 then P × P, P to R6. P to Kt7 (it would be quite useless to play the K on account of P to K6) P to R7. P to Kt8 (Q), P to R8 (Q). Q to Q6 (ch), K to B2. P to K6 (ch), K to Kt sq. Q to Kt8 (ch), K to R2. Q to B7 (ch), K to Kt sq. Q to B7 (ch), K to R sq. Q to B6 (ch) and wins.

SOLUTION OF PROBLEM, p. 490.

1. Q to K4 (threatening Kt to Kt3 (ch) and Kt to Q7 mate)	1. Kt to KB3 (best)
2. Q to Kt4	2. Any.
3. Kt mates accordingly.	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Correct solutions received from C. T. Grey and Eugene Hamburger.

Paired for correspondence play, Senex *v.* Clarence.

THE DIAMOND BEDS OF BRAZIL.—The diamond beds of Bahia and Minas Géraës, in Brazil, are very similar in character as regards the minerals composing them and their plateau form, or situation on watercourses. A new bed has been recently opened on the Rio Purdo in Bahia, which presents some differences to those hitherto known in Brazil. The country around is low and marshy, and covered with forests. The working of these forests has led to the discovery of the diamonds, which are found in a white clay along with beds of decomposed leaves. The deposit appears of modern formation. The minerals of the clay accompanying the diamond are, according to M. Gorceux, quartz, silex, monazite, zircon, disthene, staurotede, grenat almandine, corindon, and some oxides of iron. There are no oxides of titanium, or tourmalines, as is frequently the case in diamond beds. The clay appears to be from its character and situation the *débris* of the granite mountains bordering on the Bahia coasts.—*Engineering.*

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SPECIAL NOTICE.

Part XXXII. (June, 1884), now ready, price 1s., post-free, 1s. 3d.

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